



NCDA&CS
Plant Industry Division
Annual Report
2016



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NORTH CAROLINA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES



Mission Statement

The mission of the North Carolina Department of Agriculture and Consumer Services is to provide services that promote and improve agriculture, agribusiness, and forests; protect consumers and businesses; and conserve farmland and natural resources for the prosperity of all North Carolinians.

Steve Troxler
Commissioner of Agriculture
Chairman, Board of Agriculture

North Carolina Board of Agriculture



Maurice Berry



Ben Shelton



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ACCOMPLISHMENTS: ADMINISTRATIVE AND SUPPORT SERVICES SECTION

The NCDA&CS state authorized budget for 2015-16 was \$5,850,180 and included a total staff of 84 full-time employees. The Plant Industry Division continued its work with other organizations, both public and private, through the administration of cooperative agreements. For the period, approximately \$1,941,557 in cooperative agreements was received and administered for work with joint plant pest regulatory programs. Figure 1 provides a summary of the Plant Industry budget for the 2015-16 fiscal year.

The Plant Industry Division, Support Operations Unit provides support for all the division's programs, including staff and maintenance of Division owned vehicles and other equipment needed for all service and regulatory programs. This unit also assists the Division with the implementation of safety/seasonal orientation.

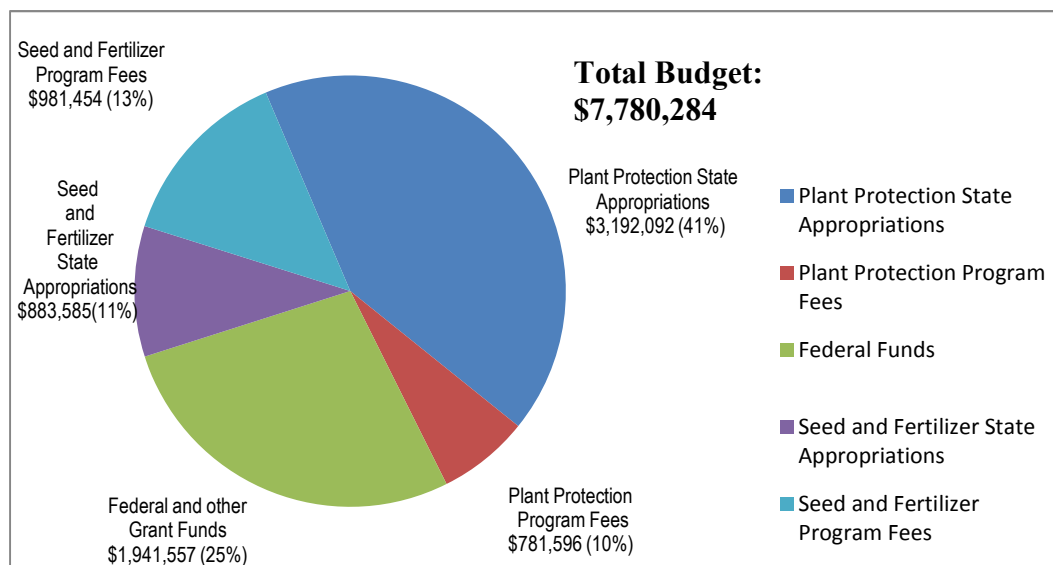


Figure 1 Plant Industry FY 2015-16 Budget Summary

ACCOMPLISHMENTS: PLANT PROTECTION SECTION

The mission of the Plant Protection Section is to enhance the quality of life in North Carolina by protecting agriculture and the environment from injurious plant pests, by promoting beneficial organisms, and by protecting rare native plants of the state.

We serve the people of North Carolina by:

- Protecting agricultural crops, horticultural crops and native flora, by preventing or controlling the invasion and spread of injurious insects, plant pathogens, weeds, and other pests of regulatory concern.
- Protecting honey bees by combating the spread of bee pathogens.
- Responding to constantly changing threats to crops, rare native plants, and honey bees by drafting effective and reasonable regulations and by achieving public compliance.
- Supporting agriculture, horticulture and related industries by providing inspection and export services to facilitate the movement of regulated commodities.
- Protecting rare native plants by restoring their habitats, and by propagating and restoring them to the wild.
- Promoting beneficial organisms that serve as biological controls of pest species.
- Providing outstanding service and satisfaction to all our clients.

North Carolina has an extremely wide range of climate, from near tropical along the southeast coast to winter conditions similar to southern Canada in our higher mountains in the west. Such diversity provides suitable environments for an extremely diverse flora and fauna. Extensive international air and sea transportation, both military and commercial, and an extensive Interstate Highway System increase the potential for the accidental introduction of pest organisms into North Carolina. Therefore, North Carolina's Plant Protection Section programs must deal with a wide range of organisms and host-pest interactions.

Major program activities for the period January 1 through December 31, 2016 are described in the following reports.

Apiary Inspection Program

The primary mission of the Apiary Inspection Service is to maintain a viable beekeeping industry and ensure the productivity of North Carolina's diverse agriculture. The North Carolina beekeeping industry continues to remain viable and is expanding, particularly with new hobby beekeepers. Our inspectors assist beekeepers through field inspections, educational meetings and field days, and attempt to be available to assist the beekeepers in any way necessary. Our goal is to further improve our overall inspections and ultimately, to reduce the rate of honey bee disease and pest problems.



Figure 2 European honey bee

To protect the health of our honey bee industry, permits to sell bees are required for anyone wishing to sell queens, package bees, nucs, or hives. In 2016, 105 permits were issued to sellers in-state and 16 to out of state dealers. To obtain a permit, bees must be inspected and the producers must agree to comply with standards designed to maintain healthy colonies. Beekeepers are strongly encouraged to buy only from permitted dealers so as to avoid buying unhealthy or Africanized honey bees. The permit list can be found at: <http://www.ncagr.gov/plantindustry/Plant/apiary/documents/PermitToSell2017.pdf>.

One of the most devastating and difficult to control bee diseases is American foulbrood (AFB). It still appears that our AFB incidence is below 1%. We have maintained the Special Local Need 24(c) registration for the ethylene oxide (EtO) fumigation chamber, as well as a source for the EtO formulation. We are currently providing decontamination services to the beekeepers of North Carolina with the chamber, and it is our belief that it is a valuable tool in controlling AFB as well as other serious pests and diseases.

The mite *Varroa destructor* persists as a major threat to the beekeeping industry in NC and is probably a contributing factor to general poor health or mortality of bee colonies. Several new miticides have been registered; however, the mites have developed resistance to some of these materials in short order and rendered these products ineffective. Currently, the list of registered products for *Varroa* control in North Carolina includes Apistan®, CheckMite+®, Api-Life Var®, Apiguard®, Mite-Away Quick Strips®, Apivar®, oxalic acid (specifically labeled for bees), and HopGuard®. All of the aforementioned products are listed in North Carolina as Section 3 general use pesticides. Although chemical treatment of mites may be necessary, some miticides have been demonstrated to have adverse effects on bees. The growing use of unregistered materials may have adverse effects on honey bee health and may not be efficacious in controlling mites. This and, in some cases, the improper use of antibiotics to control diseases can further complicate useful treatment regimes.

Beekeepers are expressing concerns about pesticides, particularly the neonicotinoids. Bee yards can be registered through the Plant Industry Division. The list of registered yards is sent to Aerial Applicators licensed in North Carolina. For more information about registering, see: <http://www.ncagr.gov/plantindustry/Plant/apiary/documents/BS2ApiaryRegistrationForm01-2017.pdf>.

The NCDA&CS Apiary Inspectors have developed a good working relationship with the Structural Pest and Pesticides Division of the Department. The Pesticide Division responds to reports of acute bee losses and follows up according to the evidence. If a pesticide problem is suspected, timely reporting to an Apiary Inspector or the Pesticide Section is crucial for a valid investigation and resolution. Apiary personnel have collected pollen samples from colonies suspected to be suffering sublethal effects of exposure to neonicotinoids. To date, the samples have contained no detectable levels of these chemicals. The Structural Pest Control and Pesticide Division and the Plant Industry Division are working with the U.S. Environmental Protection Agency to develop a Managed Pollinator Protection Plan.

Colony Collapse Disorder (CCD) remains a major topic of discussion among beekeepers. The press coverage has highlighted the value of honey bees to a broader audience and raised awareness of their importance. Our inspectors have seen colonies that share many of the symptoms attributed to CCD, but due to the restricted parameters described as symptoms of CCD, this disorder has not yet been documented in North Carolina. This is not to say that it has not occurred here, but we still have not seen evidence specifically attributable to this condition. Most of the colonies we have inspected that show symptoms correlating to CCD reveal evidence of high mite loads or other familiar disorders.

Another threat facing the beekeeping industry of North Carolina is the establishment of Africanized honey bees (AHB) (*Apis mellifera scutellata*) in southern Florida (and finds in Georgia). We are maintaining swarm traps at the ports of Wilmington and Morehead City in order to intercept any bees coming in via ship. We hope to expand this trapping system to some of our land-based points of entry. We continue to engage in an outreach program to North Carolina emergency response personnel to familiarize them with the potential threat of AHB. We are actively collecting samples of bees (particularly those from colonies with overly defensive behavior) to determine their geographic origin and their propensity for this behavior. The NCDA&CS and North Carolina State University are collaborating in conducting this survey. At this time, none of the samples collected have been determined to be of the AHB type. We are striving to have our inspectors and our lab prepared to deal with any AHB incursion or incident. **We encourage beekeepers and the general public to please let us know of any colonies that seem to be displaying any unusual behavior, especially excessive defensiveness. We want to maintain a beekeeping industry in North Carolina that is not threatened by the reputation of this more defensive type of bee.**

We continue to enjoy a good working relationship with our friends in the North Carolina State University Apiculture Research and Extension Program. We have had the opportunity to assist them in some of their projects and would like to express our gratitude for their assistance in many of our projects.

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North Carolina Department of Agriculture and Consumer Services, Plant Industry Division

The Apiary Inspection Program is based at the Beneficial Insects Lab, and Glenn Hackney, Research Specialist maintains a lab at that location. Other Apiary staff are based at their homes across the state. During 2016, the inspectors were: Greg Farris, western Piedmont; Nancy Ruppert, Sandhills; Will Hicks, central counties; Adolphus Leonard, Coastal Plain; Lewis Cauble, mountain territory; and Don Hopkins, State Apiarist and Apiary Inspection Supervisor.

Biological Control Programs



CERCERIS FUMIPENNIS AND
PREY



HEMLOCK WOOLLY ADELGID



IMPORTED FIRE ANT AND
PHORID FLY



MILE-A-MINUTE VINE WEEVIL

2016 Annual Report

North Carolina Department of Agriculture and Consumer Services, Plant Industry Division

The mission of the biological control program is to manage exotic pests using ecologically-based methods. We focus on classical biocontrol, reuniting exotic pests with the natural enemies that keep them below damaging levels in their home ranges. Although we are primarily an implementation program, conducting these projects requires research to ascertain the appropriateness of releasing biological control agents or to follow up on agents released. Currently, our projects focus on a variety of exotic insects and weeds, and involve laboratory rearing of insects, field releases of natural enemies, and surveying. Our quarantine facility remains useful to our division as well as to outside cooperators as a secure space for research and monitoring of pests. Personnel working in the program during 2016 included Kathleen Kidd, Former Biological Control Administrator (retired September, 2016), Steven Turner, newly hired Biological Control Administrator (hired December 2016), Christine Nalepa, Research Specialist, and Nancy Oderkirk, Research Specialist and safety officer.

**Implementation of *Cerceris fumipennis* as a Biosurveillance Tool for
Pest Buprestidae in North Carolina during 2016**

The solitary ground nesting wasp *Cerceris fumipennis* continues to be utilized as a biosurveillance tool for the efficient collection of pest buprestid beetles in Canada and in several locations in the eastern and central United States. In 2016 studies of the wasp in North Carolina were continued in partnership with the Cooperative Agricultural Pest Survey (CAPS); we conducted biosurveillance and surveyed for new sites between 12 May and 20 August 2016.

Biosurveillance was conducted in 11 established sites in 10 counties (Table 1). A total of 594 beetles were collected (591 during biosurveillance and an additional 3 during surveys – Table 2). The first beetle collected was in Robeson Co. on 1 June and last beetle taken was on 7 July in Franklin Co. About 19% of collected beetles were in the genus of interest *Agrilus*; those *Agrilus* identified to species include *A. bilineatus*, *ferrisi*, *lecontei*, *ruficollis*, *vittaticollis*, and the emerald ash borer (EAB) *A. planipennis*. Species level identification is still pending for 180 beetles.

Emerald ash borer was brought back to the nest by *C. fumipennis* in four sites. Two of these (Sites #7 and 11 - Table 1) were new county records (Swain, Yancey) for the pest. EAB comprised 13.2% of the beetles collected in the Swain Co. site, and 15.2% of the beetles in the Yancey Co. site. In the other two sites (Sites #2 and 10 -Table 1) EAB was already known to be in the county; nonetheless it was the first time that EAB was collected from wasps at these nesting aggregations. Biosurveillance was conducted at the Franklin Co. site where wasps first collected EAB in 2015 (Site #4 – Table 1). EAB was not found among the 78 beetles collected there in 2016.

During surveys for nesting aggregations of the wasp, one new site with *C. fumipennis* nests (Site #10 - Table 2) was found in Buncombe Co. Resurveys of previously productive sites resulted in three additional sites likely appropriate for biosurveillance in 2017 (Sites #11, 12, 15 – Table 2).

An additional reported aggregation in Transylvania Co. (Site #14 – Table 2) was scouted but was determined to be an aggregation of *Cerceris halone*, a weevil-hunting wasp. This wasp has an appearance and nest similar to that of *C. fumipennis* and typically nests in comparable areas.

A manuscript on the collection of EAB at the Franklinton site in 2015 was submitted and has been accepted for publication:

Nalepa, C.A., R.S. Norris and W.G. Swink. 2017. Collection of emerald ash borer by *Cerceris fumipennis* in North Carolina: case study at one nesting site. *Journal of Entomological Science* (in press).

Sue Dial, Jarred Driscoll, Larry Green, Mike Hodges, Heidi Humlicek, Kathleen Kidd, Alan Larkins, Christine Nalepa, Nancy Oderkirk, Michelle Shooter, and Whitney Swink participated in the program by conducting biosurveillance, scouting new sites, identifying beetles and/or training participants.

Table 1 Biosurveillance conducted for pest Buprestidae at known sites of *Cerceris fumipennis*

Site #	County	Site Name	Total Buprestidae	EAB?	Dates EAB Collected
1	Alamance	McCray	54	-	
2	Buncombe	Vance Elementary	55	6	13, 14 June
3	Franklin	Luddy Park	49	-	
4	Franklin	Franklinton Park	78	-	
5	Gaston	Aaron Moss, Cherryville	38	-	
6	Robeson	Bradford Pool	31	-	
7	Swain	Swain Recreational Park	68	9	19, 20 June
8	Surry	Meadowview Middle School	24		
9	Wake	Lake Lynn	64	-	
10	Wayne	Faith Christian Academy	84	3	2, 4, 9 June
11	Yancey	Mtn Heritage High School	46	7	27, 28, 29 June
	TOTAL		591	25	

Table 2 New Survey/Re-Survey for *Cerceris fumipennis* for nests in 2016

	Site	Dates Surveyed	Results
1	Robeson 6 – 2012; Sycamore Park	12 May	0 nests
2	Robeson 12 – 2012; St. Pauls	12 May	0 nests
3	Brunswick 1 – 2016; Leland Middle School	19 May	0 nests
4	Brunswick 2 – 2016; Mary S. Jenkins Park	19 May	0 nests
5	Brunswick 3 – 2016; Town Creek Elementary	19 May	0 nests
6	New Hanover 1 – 2010; Maides Park	26 May; 1, 30 Jun	0, 0, 0 nests
7	New Hanover 14 – 2010; Optimist Park	26 May; 1, 30 Jun	1, 0, 0 nests
8	New Hanover 19 – 2010; Wilmington Christian Acad	26 May	Field gone
9	New Hanover 22 – 2010; Emma Trask Middle School	26 May	0 nests
10	Buncombe 33 – 2016; Black Mtn Vets's Park	21 June	12–24 nests; 3 drops
11	Alamance 22 – 2014; Hawfield's Middle School	6 July	10 nests on field 2
12	Caswell 1 – 2012; Bartlett Yancey HS	6 July	10 nests
13	Orange 8 – 2016; Cedar Grove Ruritan Club	6 July	0 nests
14	Transylvania 1 – 2016; Cascade Lake	7 July	≥ 70 nests <i>C. halone</i>
15	Polk 2 – 2011; Mill Spring	12 July	5, 17 nests

Hemlock Woolly Adelgid Predator Rearing

The primary objective for this project was for NCDA&CS to operate a large-scale central rearing facility to provide biological control agents for the management of hemlock woolly adelgid (HWA). *Sasajiscymnus tsugae* (St), native to Japan has been in mass production at the lab since December 2002. The current colony originated from beetles supplied by Patrick Parkman of the Lindsay Young Beneficial Insect Lab of the University of Tennessee.

The hemlock woolly adelgid is now ubiquitous throughout the native range of the eastern and Carolina hemlock species. Hemlock is widespread in National and State Forests and Parks, and the loss of the hemlock is causing major changes to the ecology of those areas. In addition to a loss of a unique ecosystem, dead and dying trees are a safety hazard in recreation areas, as well as aesthetically unattractive. Although targeted chemical control measures are recommended for specimen trees, control with insecticides is both technically complicated and economically impractical in forest settings. Because the hemlock stands and HWA infestations are scattered over a wide area, rearing and releasing large



Figure 3 Dead hemlock trees in Linville Gorge, NC 2012.

numbers of predator beetles in carefully-selected areas is preferred to relying on long-range natural spread. To date, rearing facilities supported by the USDA-FS have provided these agents for coordinated releases in the southeastern United States.

Predatory beetles native to regions where the adelgid occurs naturally are well synchronized with the lifecycle of the adelgid. The adelgid becomes dormant for the summer as early stage settled nymphs, and in response, the beetles also enter a period of reproductive dormancy. At the end of their aestivation period in western North Carolina, when the adelgids begin to mature and prepare for oviposition, our team collects hemlock boughs for storage in spring-like conditions to stimulate oviposition.

We follow a slightly modified rearing protocol developed originally at the Amalpi Beneficial Insect Laboratory of the New Jersey Department of Agriculture. To increase the colony, mating groups of 15 beetles (10 female, 5 male) are placed in gallon jars supplied with a bouquet of hemlock twigs and small squares of gauze. Eggs (on the twigs and gauze) are removed weekly and put into rearing cages supplied with adelgid-infested hemlock. Infested twigs, honey, and water are supplied periodically, and after 4 weeks, adult beetles are collected and moved into storage cages. Oviposition jars for the 2015-2016 season were set up beginning 2 November 2015 with 24 jars. Oviposition concluded in early June 2016. A colony of about 1500 beetles was maintained through the summer.

We maintained this year's *S. tsugae* colony by collecting adelgid-infested hemlock from state parks in western North Carolina about every three weeks. The beetles regularly oviposited high numbers of eggs, but maturation rate remained low (around thirteen percent.) We regularly detected and removed naturally-occurring predatory beetles and lacewing larvae from the collected hemlock branches, but found adult lacewings on several occasions. Hence, predation by these occasional generalist predators probably reduced our production numbers.

During the 2015-16 production season, an estimated 54,000 eggs were oviposited and 7200 *S. tsugae* beetles were produced. Beetle production peaked in late February and early March. Our predator colony was maintained primarily by Rebecca Fergus, Research Specialist $\frac{3}{4}$ time, through the production period. Nancy Oderkirk assisted with collection of hemlock and rearing of an experimental colony of *Scymnus coniferarum* beetles, then assumed all aspects of the project starting in August.

In 2016, we began development of a lab rearing protocol for the Conifer Lady Beetle, *Scymnus coniferarum*, another potential biological control for HWA. Nancy Oderkirk is continuing that process, and will test the suitability of the dietary supplement currently used with *S. tsugae*.

Also in 2016, we collaborated with USDA scientist Robert Hollingsworth to test the efficacies of various entomopathogenic fungi on HWA. These studies are ongoing, with promising initial results.

Field Release and Monitoring of Phorid Flies *Pseudacteon* spp for the Imported Fire Ant

Since the discovery of the imported fire ant (IFA) in NC in 1953 it has spread to approximately 90 out of 100 counties (NCDA&CS, 2013). In an effort to slow the spread and decrease population size, biological control measures have been undertaken across the state. A complex of flies in the family Phoridae is known to attack *Solenopsis* spp. ants in their native South America (Porter, 1998). The phorid fly, sometimes referred to as the decapitating fly, lays individual eggs into worker ants while they forage or defend their mounds. After hatching, the fly larva moves into the ant's head to feed, and consumes soft tissue, eventually resulting in the ant's head falling off (Porter et al, 1995). When phorid flies are present, ants decrease foraging to avoid the flies. Less foraging activity results in fewer ants and smaller and/or fewer mounds, allowing native ants and other insects to better compete for resources (Mehdiabadi et al, 2004).

Releases. Since 2000, 4 species of phorid flies *Pseudacteon tricuspis*, *P. curvatus*, *P. obtusus* and *P. cultellatus* have been released in 11 counties of North Carolina (Table 3). The species of phorid flies selected for release at each locality was based on the most prevalent type of ant colonies present: monogyne colonies with one queen or polygyne colonies with multiple queens (Table 3). *P. tricuspis* and *P. obtusus* flies typically attack larger workers usually found in the monogyne colonies whereas *P. curvatus* and *P. cultellatus* shows a preference for smaller workers common to polygyne colonies (Morrison et al. 1997).

Surveys. A modified version of sticky traps developed by Puckett et al. (2007) was used to monitor for *P. obtusus* and *P. cultellatus* in Johnston, Wake and Franklin County. The traps consist of plastic tri-stands (used to keep the pizza from sticking to the delivery box) glued to 60 x 15 mm plastic petri dishes. The pizza tri-stand and sides of the petri dishes were coated with Fluon™ to prevent the fire ants from escaping and climbing the tri-stand. Inverted tri-stands were anchored to the single tri-stand with Velcro, and the legs of the inverted stands were coated with Tanglefoot® (Figure 4). Traps were placed at or near the fire ant mounds and baited with live ants and bits of Vienna sausages to attract phorids. Flies became ensnared in the Tanglefoot® when they alighted to rest on the upright legs.



Figure 4 Sticky trap for capturing phorid flies.

Following the survey work conducted in 2015 (refer to 2015 NCDA&CS BioControl & Apiary Annual Report), no additional surveys were conducted in 2016. However, we see this as a continuous project. We will conduct surveys in the summer of 2017 in order to assess establishment and persistence of phorids in the release areas and also plan to assess whether the flies are dispersing to neighboring areas. We also plan on conducting additional releases in counties where fire ants have recently been newly detected.

Table 3 Site information for *Pseudacteon* releases

County	Year	Species	Number (estimated)
Beaufort	2000	<i>Pseudacteon tricuspis</i>	3000
Duplin	2002	<i>Pseudacteon tricuspis</i>	2973
Robeson	2003	<i>Pseudacteon tricuspis</i>	3849
Wayne	2004	<i>Pseudacteon tricuspis</i>	5000
	2008	<i>Pseudacteon curvatus</i>	12,000
Wake	2005	<i>Pseudacteon curvatus</i>	13,708
	2013	<i>Pseudacteon cultellatus</i>	6096
	2013	<i>Pseudacteon obtusus</i>	1404
Pitt	2006	<i>Pseudacteon tricuspis</i>	3639
	2010	<i>Pseudacteon curvatus</i>	12,000
	2010	<i>Pseudacteon obtusus</i>	1100
Scotland	2007	<i>Pseudacteon tricuspis</i>	5206
		<i>Pseudacteon curvatus</i>	13,008
Gaston	2009	<i>Pseudacteon curvatus</i>	11,000
Randolph	2011	<i>Pseudacteon curvatus</i>	4914
		<i>Pseudacteon obtusus</i>	2984
Franklin	2012	<i>Pseudacteon curvatus</i>	9312
		<i>Pseudacteon obtusus</i>	2417
Johnston	2014	<i>Pseudacteon obtusus</i>	5077
		<i>Pseudacteon cultellatus</i>	4128
Anson	2015	<i>Pseudacteon obtusus</i>	1364
		<i>Pseudacteon cultellatus</i>	9408

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Mile-A-Minute Vine Biological Control

Native to Asia, mile-a-minute vine (MAM), *Persicaria perfoliata* (L.) H.Gross, is a fast-growing member of the Polygonaceae family. Hough-Goldstein et al. (2008) provided an overview of the biology and biological control of *P. perfoliata*. This invader has been present in the USA since the mid-1930s. A sun-loving annual vine, it is frequently found in riparian areas and can quickly grow over other vegetation (Figure 5). MAM is easily identified by its key characteristics: triangular leaves, spines on the reddish-colored stems and leaves, and a modified leaf (ochrea) that surrounds each node of the vine. Small white flowers develop into berry-like fruit that turns a bright metallic blue. Seeds can remain viable in the soil for up to 6 years and spread via waterways, birds, and mammals.



Figure 5 Mile-a-Minute vine overgrowing other vegetation.
Adult weevil damage can be seen on the foliage. Alleghany County weevil dispersal site, 2015.

Rapid growth, prolific flowering, long-lived seeds, a preference for riparian areas and ability to overtop most native plants make chemical control of MAM difficult. Biological control is often the most practical strategy for dealing with this weed.

The USDA Forest Service and the University of Delaware initiated surveys for natural enemies in Asia, and *Rhinoncomimus latipes* Korotyaev was selected as the most promising species from China and Japan. The weevil was tested for feeding on non-target plants, and none were found. This weevil has been released in numerous states in the eastern United States, and is currently being reared at the Philip Alampi Beneficial Insect Lab (PABIL) of the New Jersey Department of Agriculture. Adult weevils feed on the foliage of the plant, but larvae tunnel within stems.

Surveys. Delimiting surveys have been conducted to determine the extent of MAM infestations after populations were initially reported. These were “windshield” surveys, looking for populations along the roadsides, or walking/wading to map infestations along stream banks. “Float” surveys were conducted along the Mayo and Dan Rivers in Rockingham County. After weevil releases, sites have been visited at least once annually, and delimiting surveys for weevil spread were conducted in Gates, Pasquotank, and Alleghany Counties in 2016. When a population of MAM was found, plants were searched visually or by tapping to dislodge insects until weevils were found. If no weevils were found, the search ended after 15 minutes.

Results and Establishment. A summary of weevil releases is shown in Table 4. Weevils have been released in multiple years at sites with dense populations, resulting in 25 unique sites in 6 counties over a period of 6 years.

Mile-a-minute vine is widely distributed in North Carolina, from the mountains to the coast (Figure 6). Infestations vary in their density and size. Alleghany County has multiple streamside and roadside infestations that range from small patches to dense thickets. Weevils have persisted at all release sites for one or more years after release, and dispersal of almost 5km from release sites has been documented (Figure 7).

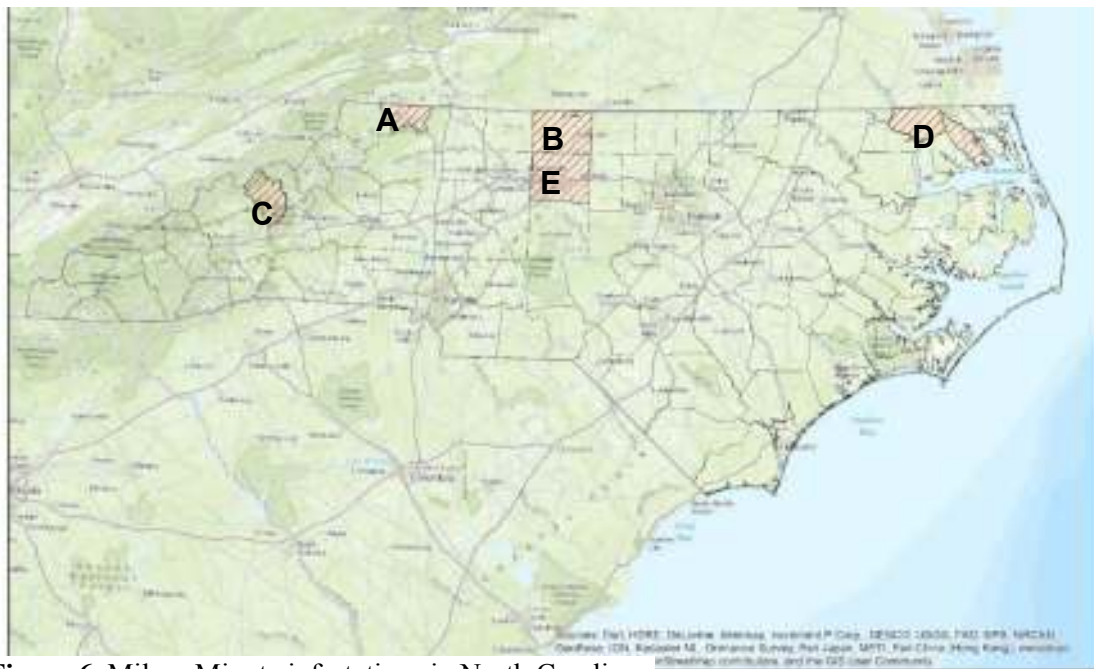


Figure 6. Mile-a-Minute infestations in North Carolina.

Counties with hatch markings are infested. Letters correspond with the order in which county infestations were reported. A = Alleghany, B = Rockingham, C = Yancey, D = Pasquotank and Gates, E = Guilford.

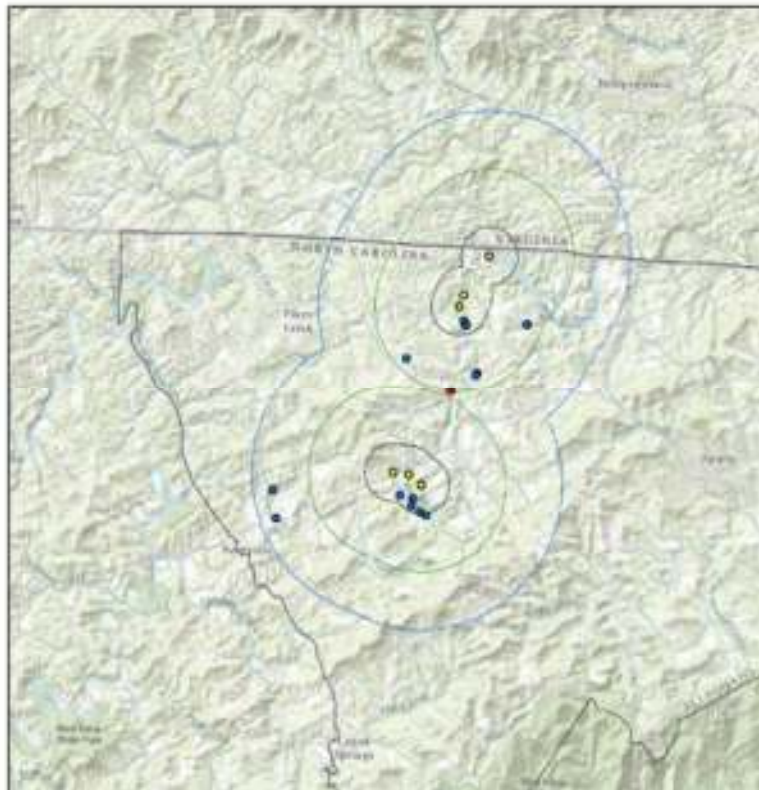


Figure 7 Alleghany County weevil releases and dispersal.

Yellow = weevil release site, *blue* = weevil recovery, *red* = MAM infestation, no weevils recovered. Buffer zones represent 1 (black), 3 (green), or 5km (blue) from release sites.

The initial Yancey County infestation was small and appeared limited in area. Weevils are considered established there after overwintering for at least three years, and in 2014 they were found up to 3km away from the release site. In 2015, no plants were found at these locations. Weevils might not account for the total disappearance of the plants. Other factors, including late frost or early season mechanical control, contribute to the relative scarcity of MAM in some locations.

In the timberland of the northeastern counties, MAM populations line the drainage ditches that cross fields as well as covering harvested fields. Weevils have been recovered annually at and near previous release sites.

Rockingham County has variable MAM populations along the Mayo and Dan Rivers, popular recreational rivers crossed by multiple power lines. The rights of way under these provide easily invaded habitat, and seeds are readily distributed by water and wildlife.

The Guilford County infestation has been detected at only one site at this time. Weevils have persisted for two years at this location, despite major disturbance due to highway construction during that time.

Table 4 Releases of *Rhinoncomimus latipes* in North Carolina by year.

Year	County	# Weevils	# Locations
2011	Alleghany	2200	6
	Yancey	200	1
2012	Alleghany	4800	6
2013	Alleghany	2500	3
2014	Alleghany	300	1
	Guilford	200	1
	Pasquotank	4000	5
	Rockingham	500	1
2015	Gates	3000	6
	Rockingham	1350	3
2016	Pasquotank	300	2
	Rockingham	300	1
Totals	6	19,650	25 (Unique)

Conclusions. Mile-a-minute vine, *Persicaria perfoliata* is found in six or more counties in North Carolina, and in habitats ranging from mountain valleys to the coastal plain. The biological control agent *Rhinoncomimus latipes* appears to be well adapted to a variety of habitats in the state, and have overwintered one or more years. They are becoming established and dispersing from release sites. These results are similar to those found in areas to the north, where weevils dispersed at rates of 125m to 3.5km per year (Hough-Goldstein et al. 2009). As weevils multiply and continue to disperse, we expect to see increased foliar damage, decreased seed production, and reduced stands.

A poster “Biological control of mile-a-minute vine in North Carolina using the weevil *Rhinoncomimus latipes* Korotyaev,” based on this work, was presented at the Annual Meeting of the Entomological Society of America, Minneapolis, MN and at the biennial EcoIPM National Ornamental Workshop, Hendersonville, NC.

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Cooperative Agriculture Pest Survey (CAPS) Program

The CAPS program is a national, early warning pest detection network, funded through a cooperative agreement with USDA-APHIS-PPQ for domestic surveillance of exotic plant pests. Such pests hold economic, agricultural and/or environmental importance to North Carolina (NC) and the U.S. and typically include plant pests that are not known to occur domestically. These surveys help safeguard our nation's agriculture and natural resources through early detection, especially by those pests that pass through front-line inspections at our ports of entry. Surveys also concentrate on pests of export significance which are of concern to our trading partners. The CAPS program follows guidelines to ensure that data, on a continuing basis, is scientifically valid, current and reliable. The state CAPS advisory committee helps drive and focus surveys for each state. Its core members include the State Plant Health Director (SPHD), State Plant Regulatory Official (SPRO), Pest Survey Specialist (PSS) and the State Survey Coordinator (SSC). Other members may be invited to provide guidance in their area of expertise. National and/or State level surveys concentrate on three main areas of importance; entomological, pathological or exotic weed species. All data collected from these surveys are entered into the National Agricultural Pest Information System (NAPIS) before December 1st for inclusion into the Nation Plant Board's annual report.

Executive Summary

The 2016 North Carolina CAPS program was successful in procuring funding for CAPS and Farm Bill surveys. Seven independent surveys were conducted throughout the state, covering 55 counties over the course of the season. Such surveys included; mollusk, forest pests, oak commodity, grape commodity, Asian defoliators, a phytophthoras state specific survey and solanaceous commodity. A total of twenty-eight different exotic plant pests were surveyed from April through the end of October, with the timing of each survey being dependent on the individual pest. All surveys were completed following the 2016 CAPS guidelines, making these survey scientifically valid for reporting data. **There were no positive detections for any of the targeted plant pests during the 2016 survey season.**

The NC CAPS advisory committee held its annual meeting on June 14th, 2016. The meeting focused on planning survey objectives for the upcoming 2017 season. All current surveys will be maintained for 2017, however ten additional plant pests will be added. Survey priorities for 2017 were determined and survey plans were made to minimize overlap across survey programs. New survey proposals were submitted through CAPS and Farm Bill section 10007 outlining the advisory committee's suggestions. All proposals have been funded for 2017 surveys.

CAPS Surveys

Three CAPS surveys were selected for the 2016 season in North Carolina; mollusk, forest pests and oak (Figure 8). All survey and trapping were accomplished using the 2016 approved methods for CAPS.

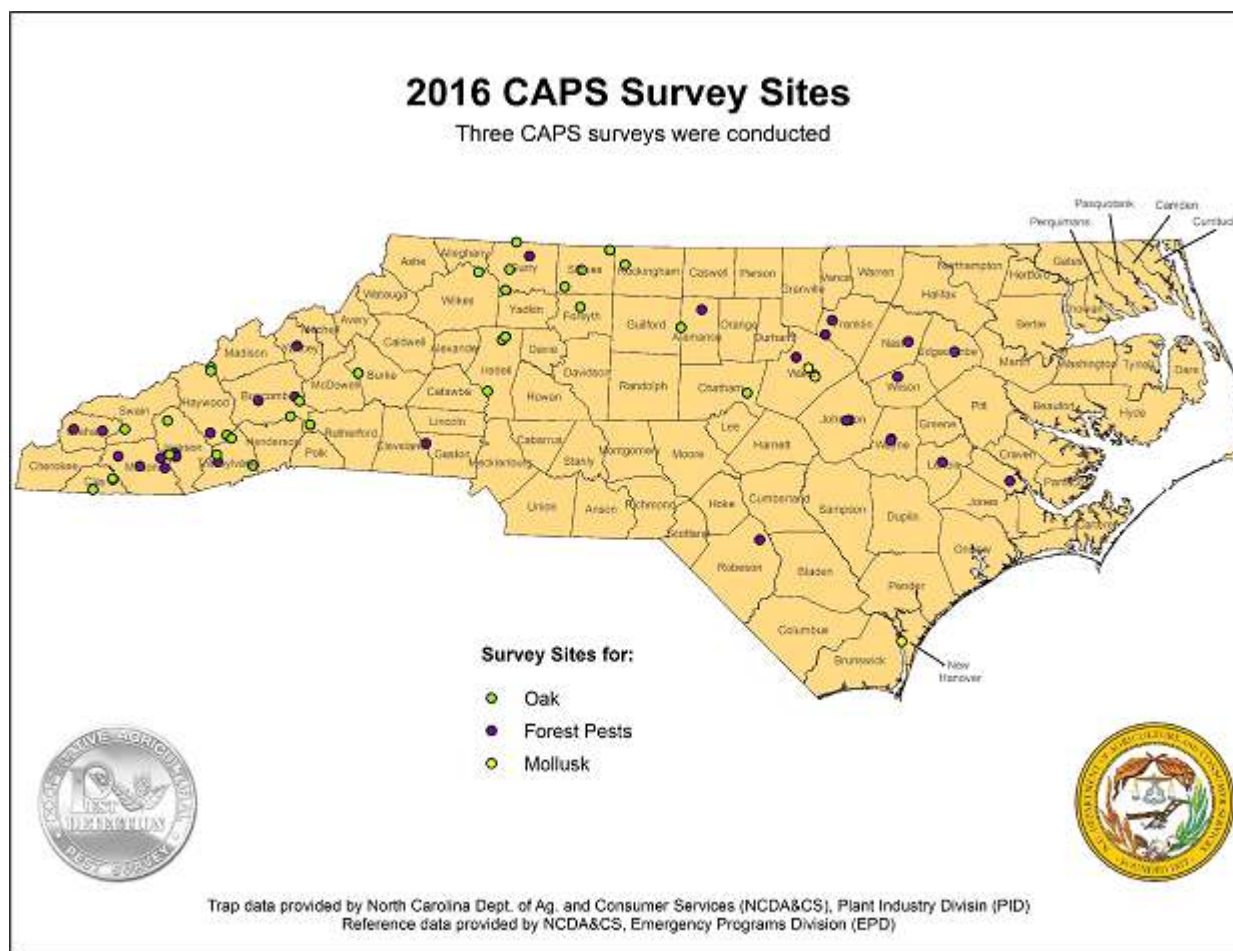


Figure 8 2016 CAPS survey sites

Mollusk Survey

The mollusk survey was completed in June and July at three locations; Port of Wilmington (New Hanover County), and two tile importers (Wake County). Three exotic species of mollusk were surveyed; giant African snail (*Lissachatina fulica*), Hygromiid snails (*Cernuella spp.*) and Leatherleaf slugs (*Veronicella spp.*). The Port of Wilmington survey was done in congruence with a special operations survey. This was a multi-departmental survey team with the help of CBP, PPQ and NCDA&CS personnel. In total, more than 20 individuals helped complete this part of the survey, covering major parts of port environs. Two tile importers were selected in Raleigh to survey for the aforementioned mollusks. The Pest Survey Specialist (PPQ) and State Survey Coordinator (NCDA&CS) worked together to complete this survey.

Forest Pests Survey

The Forest Pest survey was completed during June and July throughout the state at thirty locations (Figure 8). Three pests were surveyed; oak splendor beetle (*Agrilus biguttatus*), Goldspotted oak borer (*Agrilus auroguttatus*) and Asian Longhorned beetle (*Anoplophora glabripennis*). Both *Agrilus* species were surveyed with the help of our entomologist and the Biological Control Laboratory research specialist. Both individuals have extensive experience with the cercheris wasp and have prior knowledge of ballfields where the wasp is most prevalent throughout the state. The Asian Longhorned beetle was surveyed utilizing declining maple near industrial parks.

Oak Commodity Survey

North Carolina completed the 2016 oak commodity survey for the following exotics; Japanese oak wilt (*Raffaelea quercivora*), variegated golden tortrix moth (*Archips xylosteanus*), false codling moth (*Thaumatotibia leucotreta*), oak processionary moth (*Thaumetopoea processionea*), green oak tortrix moth (*Tortrix viridana*) and oak ambrosia beetle (*Platypus quercivorus*). Trapping for this survey began in May and ended in September. Thirty-two locations were observed for the aforementioned pests (Table 5 and Figure 8). Monthly visits were conducted for lure replacement, sticky card collection or trap replacement. Bi-weekly visits for the oak ambrosia beetle multi-funnel trap through the month of June was accomplished.

Table 5 Total number of trapping locations by county for the 2016 oak commodity survey

	County	No. Locations
1	Alamance	2
2	Alleghany	3
3	Buncombe	2
4	Burke	1
5	Chatham	3
6	Clay	2
7	Haywood	2
8	Henderson	1
9	Iredell	10
10	Macon	1
11	Madison	1
12	Rutherford	1
13	Swain	1
14	Transylvania	2
	Total	32

Farm Bill Surveys

Four Farm bill surveys were conducted in conjunction with the NC CAPS program for the 2016 survey season; Asian defoliators, grape commodity, solanaceous commodity and a phytophthoras survey.

Asian Defoliators

Six exotic plant pests under the Asian defoliators banner were surveyed for; Asian Gypsy Moth (*Lymantria dispar asiatica*), Rosy Moth (*L. Mathura*), Nun Moth (*L. monacha*), Pine Tree Lappet (*Dendrolimus pini*), Masson Pine Moth (*D. punctatus*) and Siberian Silk Moth (*D. sibiricus*). An introduction of any of these exotics under this banner would have serious implications for North Carolina forests. Host trees for these pests are considered economically important and include oak, pine, ash, elm, maple and walnut.

A total of 12 trapping locations were placed across the state over a four-month period from June to September (Figure 9). Monthly site visits were used to replace sticky cards and/or lures. Typical survey sites for this survey include military installations. It was previously determined that multiple survey locations exist on larger installations, and may include a combination of several forms of conveyance including deep water ports with rail yards, airstrips or a combination thereof. These are important pathways for this survey and are prioritized accordingly. All samples were collected at the servicing of each trap and screened for the presence of target pests.

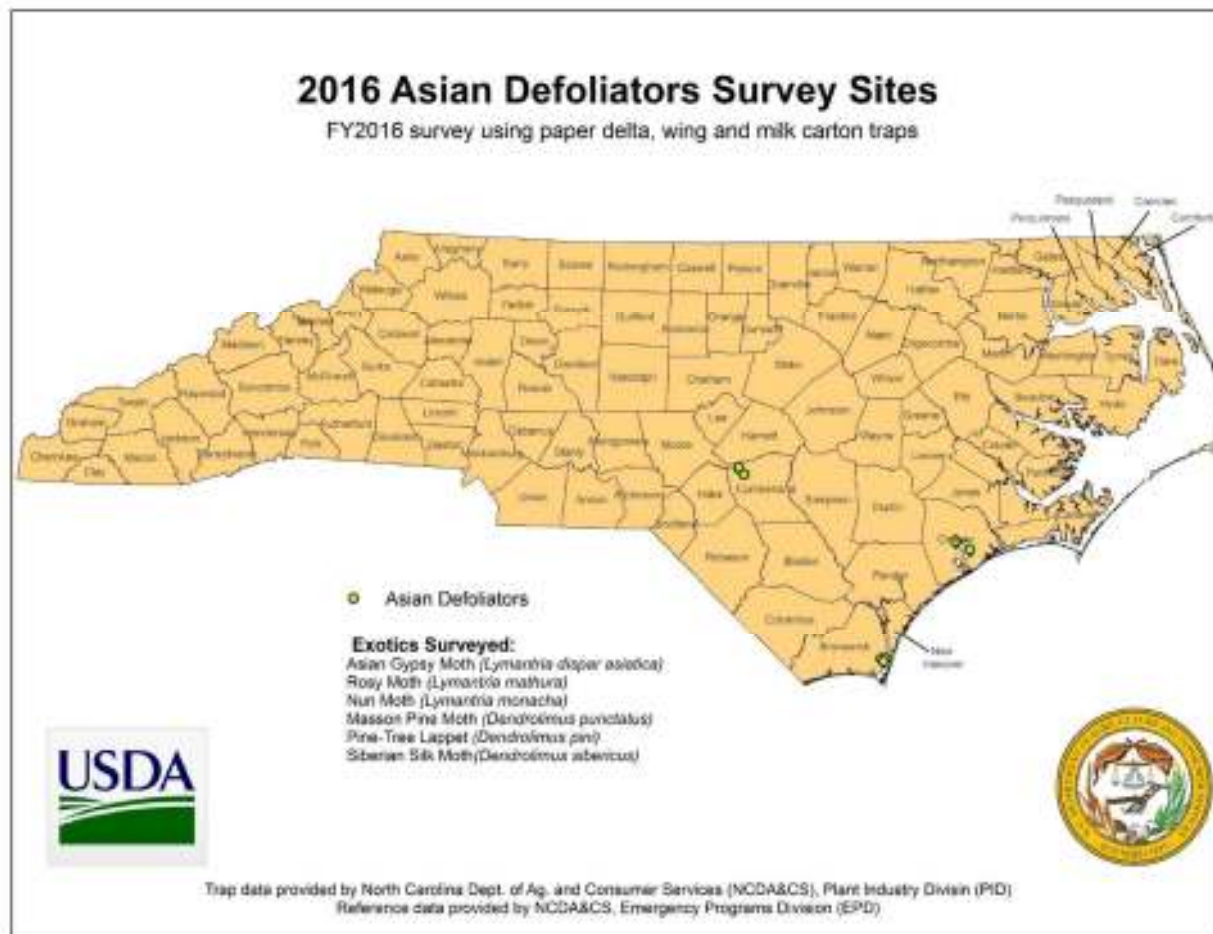


Figure 9 2016 Asian defoliators survey sites for North Carolina.

Grape Commodity

We surveyed for five exotic species; spotted lanternfly (*Lycorma delicatula*), light brown apple moth (*Epiphyas postvittana*), European grapevine moth (*Lobesia botrana*), Egyptian cottonworm (*Spodoptera littoralis*) and cotton cutworm (*Spodoptera litura*). The survey was completed using plastic delta and bucket traps that were set in July and pulled in September. The spotted lanternfly was visually surveyed since there is no approved trap/lure combination for this pest. Trapping for the aforementioned pests was completed at eleven locations in five counties (Figure 10). Samples were collected at the servicing of each trap and screened for the presence of target pests.

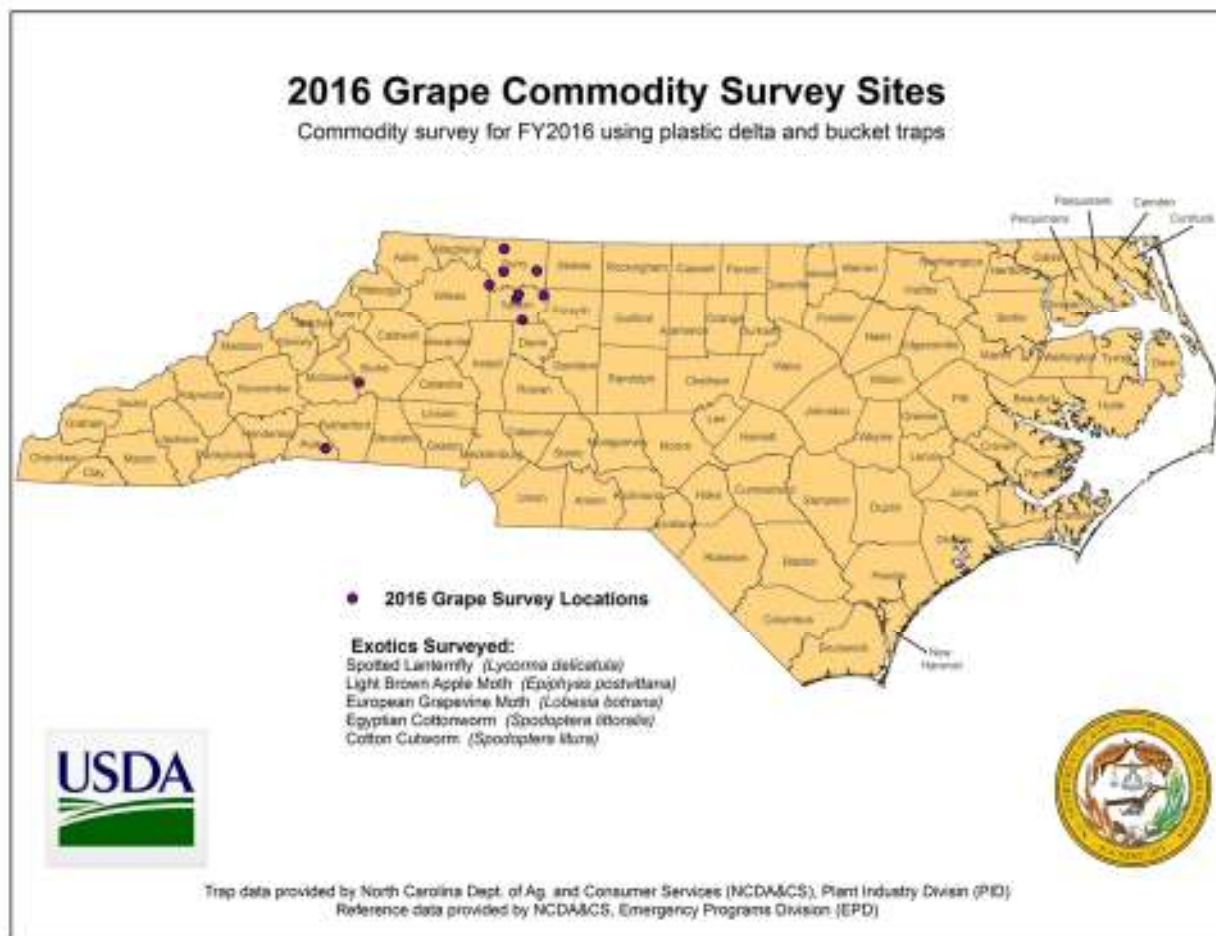


Figure 10 2016 Grape Commodity survey locations for North Carolina.

Solanaceous Commodity

Three exotic plant pests of the solanaceous commodity were surveyed; tomato leaf miner (*Tuta absoluta*), old world bollworm (*Helicoverpa armigera*) and golden twin spot moth (*Chrysodeixis chalcites*). Since North Carolina has host material, climate and pathways to support these exotics in our state and since all are regarded as being highly destructive pests of solanaceous crops, they pose a significant threat to North Carolina agriculture.

Helicoverpa armigera is found in parts of Africa, Asia, Europe, Middle East and Oceania. In early 2013, in the state of Mato Grosso, Brazil, both larvae and moths were collected from infested *Bacillus thuringiensis* (Bt) cotton fields, and were later confirmed through molecular characterization as being *H. armigera*. Old world bollworm was recently detected in Puerto Rico in September of 2014 and most recently in Florida in 2015 as an isolated incident. This pest is known for quickly developing levels of resistance to commonly used insecticides, including resistance to transgenic crops using Bt. Capable of long distance migration, it may adapt to environmental conditions if it becomes too warm or dry. Economically, it is one of the costlier pests and reports of serious losses up to 100% are common in infested areas. Early detection and identification of this pest will limit spread to the natural environment and aid in eradication.

In all, 30 sites spread across 8 counties were chosen for this survey (Figure 11). Samples were collected from all traps and were later screened for the presence of target pests during the month of October by the SSC with assistance from a taxonomic expert hired to help with this project. The taxonomic expert performed all necessary dissections to rule out positive identifications for *Helicoverpa armigera* (Table 6). Dissections were completed on 185 suspect individuals with no positive determinations.

Table 6 Total number of dissections for old world bollworm (*Helicoverpa armigera*) from suspect samples taken during the 2016 solanaceous survey. Five of the eight counties produced suspect specimens.

County	No. Dissections
Swain	108
Haywood	21
Henderson	6
Sampson	26
Rowan	24
	185

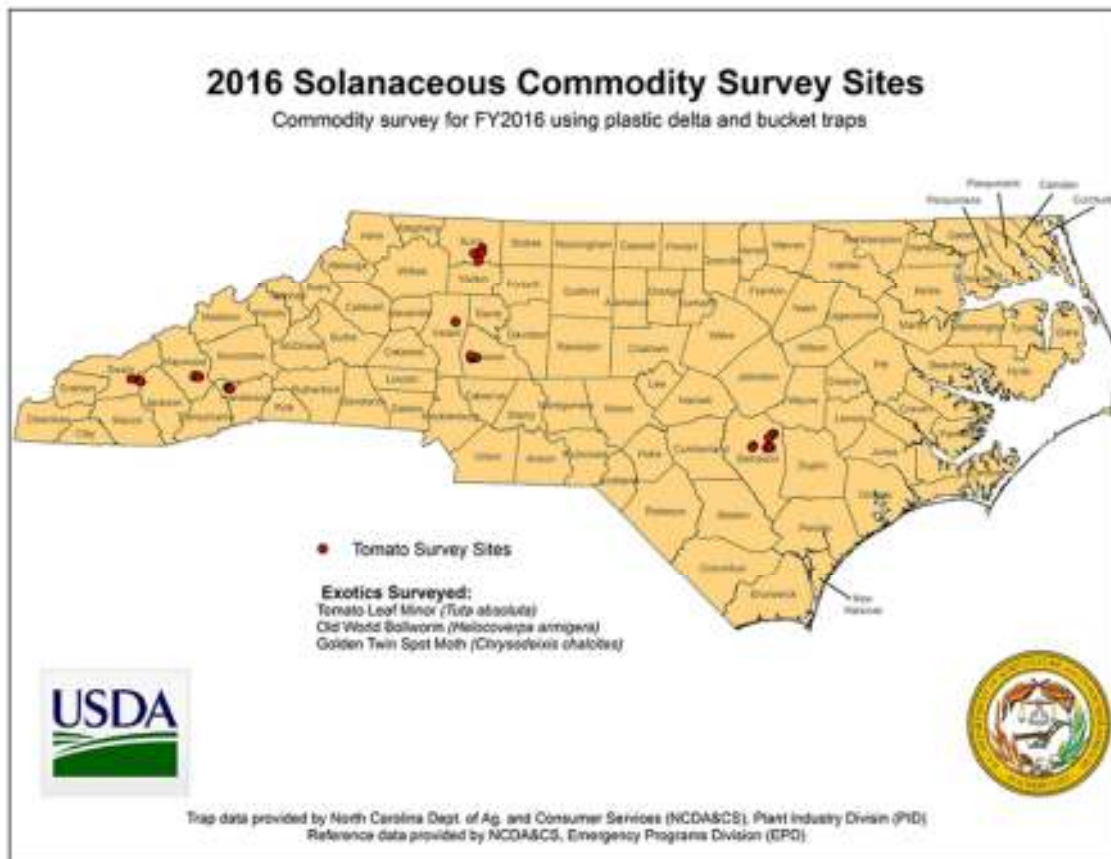


Figure 11 2016 Solanaceous survey locations for North Carolina.

Phytophthora

North Carolina conducted a *Phytophthora ramorum* and *P. kernoviae* survey during 2016. Both pathogens pose a significant threat to North Carolina forests and nurseries. *Phytophthora kernoviae*, also known as phytophthora leaf blight, is not known to occur in the U.S., but does infect important plant species including; *Quercus*, *Magnolia*, *Rhododendron* and *Pieris*. *Phytophthora ramorum*, also known as sudden oak death, has been present along parts of the Pacific Northwest since the mid-1990s and is found intermittently in Southeastern states, including NC. The primary pathway is from trade of infected ornamental plants. Since both pathogens share common hosts and affect stem and leaf tissue, a survey was developed to include both for improved efficiency. To date, close to 70 survey sites have been visited that include, “big box” retailers, nurseries and stream side vegetation surveys (Figure 12). Thirty-nine suspect samples were screened for the presence of *Phytophthora spp.* of which two samples tested positive. These positive samples were then forwarded to Kansas State University-Manhattan Diagnostic Laboratory for further diagnostics. Both positive samples tested negative for our targets. This survey is still ongoing.

A gap in our knowledge and understanding of which *Phytophthora spp.* currently infect NC nurseries and natural environs exists and we look to close this gap in future farm bill funding. Identification of

such species as it relates to location and plant material being infected will aid in discerning high risk areas for these important plant pathogens and present an opportunity in potentially describing rare, unknown or not known to occur in NC plant pathogenic phytophthoras.

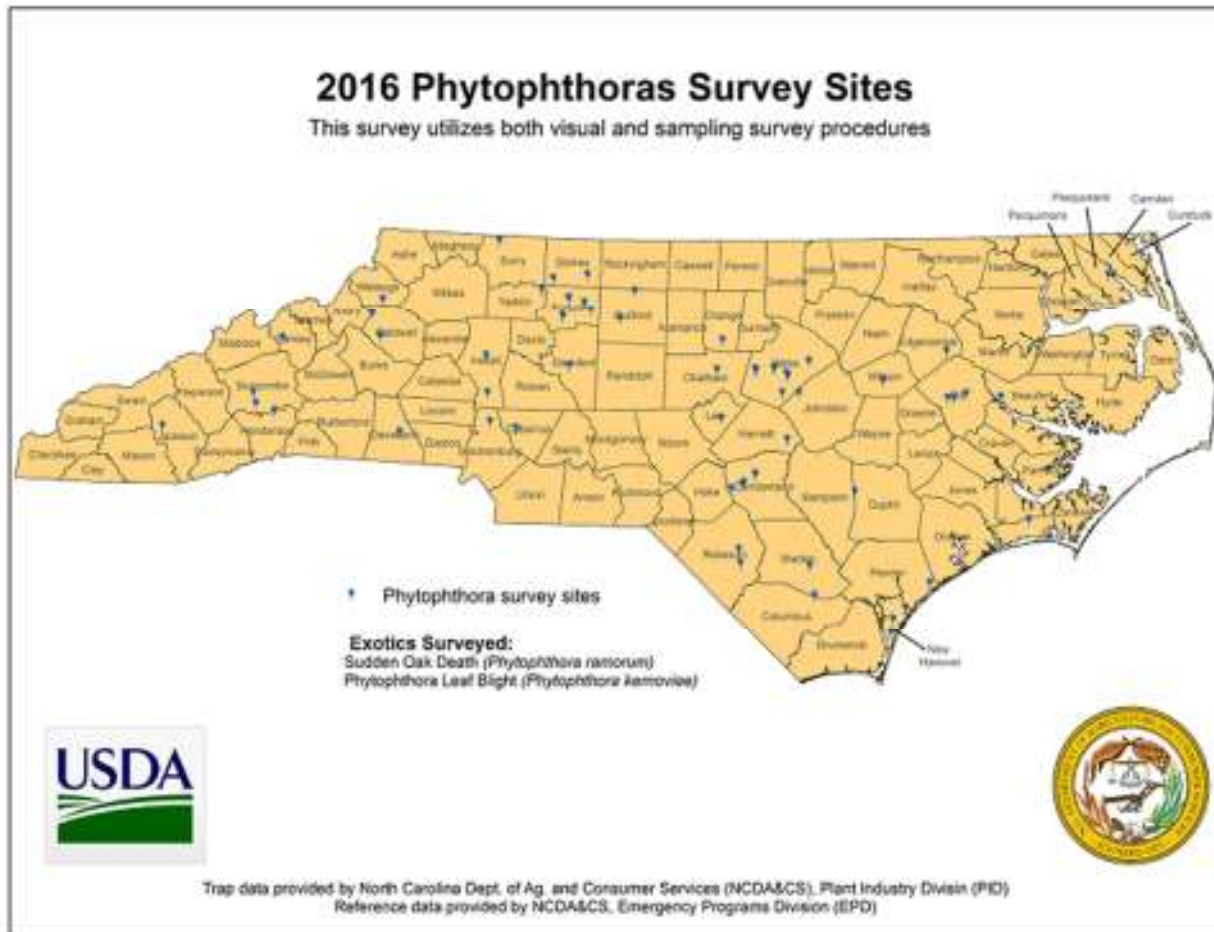


Figure 12 2016 Phytophthoras survey locations for North Carolina.

Entomological Programs

The following report summarizes the primary activities and accomplishments of the NCDA&CS Entomological Programs in 2016. With the decision to fully quarantine the entire state of North Carolina for emerald ash borer in 2015, we stopped our trapping for the pest in 2016. Additionally, the Walnut Twig Beetle Program was adopted by our Plant Pathologist as the insect vectors a pathogen that is the actual cause of tree mortality so the program is discussed in greater detail in the plant pathology report.

Sweet Potato Weevil Program

North Carolina's sweet potato production continues to increase as demand for sweet potatoes increases in the national and international markets. The success of the sweet potato industry in NC is attributed to several factors including an efficient marketing strategy and strong research programs at state universities aimed at developing new and better varieties of sweet potatoes. Additionally, at NCDA&CS Plant Industry Division, we manage an intensive regulatory program intended to keep the sweet potato weevil (*Cylas formicarius*; SPW), the most important pest of sweet potatoes in the world, out of the production areas in NC. SPW is a pest of regulatory concern that can significantly affect the NC sweet potato industry by 1) reducing yields in affected fields, 2) damaging the quality of infested sweet potatoes, 3) increasing the production cost for farmers, and 4) imposing restrictions to the movement of sweet potato from affected to non-affected areas in NC and outside of NC.

Our mission at NCDA&CS Plant Industry Division is to implement effective plant pest programs to reduce the risk of accidental introductions of SPWs into the NC sweet potato production areas and to mitigate and eradicate weevil populations that might have been introduced to the state in order to protect the NC sweet potato industry. Early detection and rapid response (EDRR) of weevil detections is instrumental for a successful eradication program. Our most important tool for EDRR is surveys. Every year, surveys are conducted throughout the state using traps baited with lures containing a female-produced pheromone that attract male sweet potato weevils. These traps are deployed in production fields, regulatory sites including but not limited to storage, processing and packing facilities, micropropagation greenhouses, and/or any other sites where regulated articles for sweet potato weevil are found. Traps are also deployed in the NC sweet potato weevil quarantine area in New Hanover and Brunswick counties to monitor potential movement of sweet potato weevils into the production areas and to conduct research.

Field Surveys

Field surveys were conducted from early August to mid-September 2016 in 50 counties primarily in eastern North Carolina. 12,642 traps were set in 11,278 fields in approximately 93,520 reported acres (Table 7). Trap set was done following the established guidelines and protocols developed by the Southern Plant Board (SPB) in 1995. Traps were deployed at a minimum of one trap per 10 acres with a minimum of two traps per field (exceptions were made if a field was under two acres). Conventional green boll weevil traps were used because of their low cost (Figure 13-A). Traps were deployed at an average density of one trap for every 6.74 acres and left in the field for an average of 28.95 days. These values are in accordance with the established SPB sweet potato weevil survey guidelines. Custom made georeferenced pdf (GeoPdf) maps were used in mobile devices (iPad minis) to navigate and locate sweet potato fields and to collect data including time and date of trap set, field type (reported, unreported and absent) and coordinates (latitude and longitude) for each trap set. Data collected during the trap pull process include the trap condition (lost, damage, good) and the number of weevils found. **No weevils were found in field surveys during this period in 2016.**

Table 7 Summary of the 2016 sweet potato weevil field surveys in NC.

County	Reported Acres	Mapped Fields	Traps Set	Acres per Trap	Mean No. of days in the field
Anson	0.02	1	1	0.02	30
Beaufort	504.9	10	14	36.06	49
Bertie	1396.37	66	105	13.30	24.5
Bladen	428.63	53	75	5.72	29.5
Brunswick	10	3	4	2.50	29
Cabarrus	1.89	3	3	0.63	24
Camden	3	1	2	1.50	29
Carteret	56.5	5	9	6.28	25
Chowan	295.3	27	50	5.91	28.5
Columbus	1839.07	224	237	7.76	30
Craven	591.93	62	71	8.34	28.5
Cumberland	2222.23	184	240	9.26	28.5
Duplin	4749.22	445	658	7.22	28
Edgecombe	9092.34	926	1133	8.03	29
Forsyth	24.58	9	8	3.07	25
Franklin	57	9	16	3.56	28
Granville	60.43	20	21	2.88	28
Greene	5530.94	561	710	7.79	33.5
Guilford	23.4	3	2	11.70	25
Halifax	768.78	123	127	6.05	28
Harnett	2535.76	371	368	6.89	28
Hertford	162.64	64	98	1.66	24
Hoke	245.46	6	18	13.64	27.5
Hyde	141.45	6	15	9.43	46
Johnston	10725.2	1602	1556	6.89	32.5
Jones	204.76	17	24	8.53	26
Lee	24.9	7	12	2.08	23
Lenoir	2954.84	312	349	8.47	31.5
Martin	1027.15	81	105	9.78	26.5

County	Reported Acres	Mapped Fields	Traps Set	Acres per Trap	Mean No. of days in the field
Montgomery	65.93	11	10	6.59	36
Moore	47.86	12	11	4.35	23
Nash	10333.15	1533	1704	6.06	34
Northampton	160.04	10	22	7.27	24.5
Onslow	391.51	39	48	8.16	24
Orange	1.43	1	1	1.43	22
Pasquotank	33.41	6	8	4.18	27
Pitt	3431.8	401	484	7.09	33
Richmond	38.2	3	4	9.55	24
Robeson	1494.99	118	162	9.23	30
Rockingham	3.5	1	2	1.75	25
Sampson	13469.91	1339	1714	7.86	27
Scotland	267	12	23	11.61	27
Stokes	21.95	15	22	1.00	27.5
Tyrrell	5.5	2	4	1.38	39
Vance	8	1	2	4.00	28
Wake	902.08	145	126	7.16	27.5
Warren	36.42	5	5	7.28	28
Wayne	6534.83	817	923	7.08	35.5
Wilson	10591.03	1604	1334	7.94	34.5
Yadkin	1.75	2	2	0.88	26
TOTAL	93518.98	11278	12642	6.74¹	28.95²

¹Average acres per trap.²Average number of days in the field across all counties.

Regulatory sites

Sweetpotato regulatory sites include but are not limited to storage facilities, processing plants, micropropagation units and greenhouse operations growing ornamental sweetpotatoes and were surveyed all year long. Because of the inter- and intra-state movement of sweetpotatoes these regulatory sites are a high risk pathway for the introduction of sweetpotato weevil. Universal moth traps (or bucket traps) were used instead of the conventional green boll weevil traps in the field because of the higher trapping efficiency (Figure 13-B). For these operations, a minimum of two (one inside and one outside) and a maximum of four traps were set per operation. Traps were placed in strategic locations where sweetpotatoes are stored and/or in and around the locations outside the buildings where sweetpotatoes are loaded or unloaded. Lures were changed in each trap once a month and data collection was done using the same procedure detailed for the field surveys. A total of 220 regulatory sites were surveyed and **no weevils were found in storage facilities during the 2016 season.**

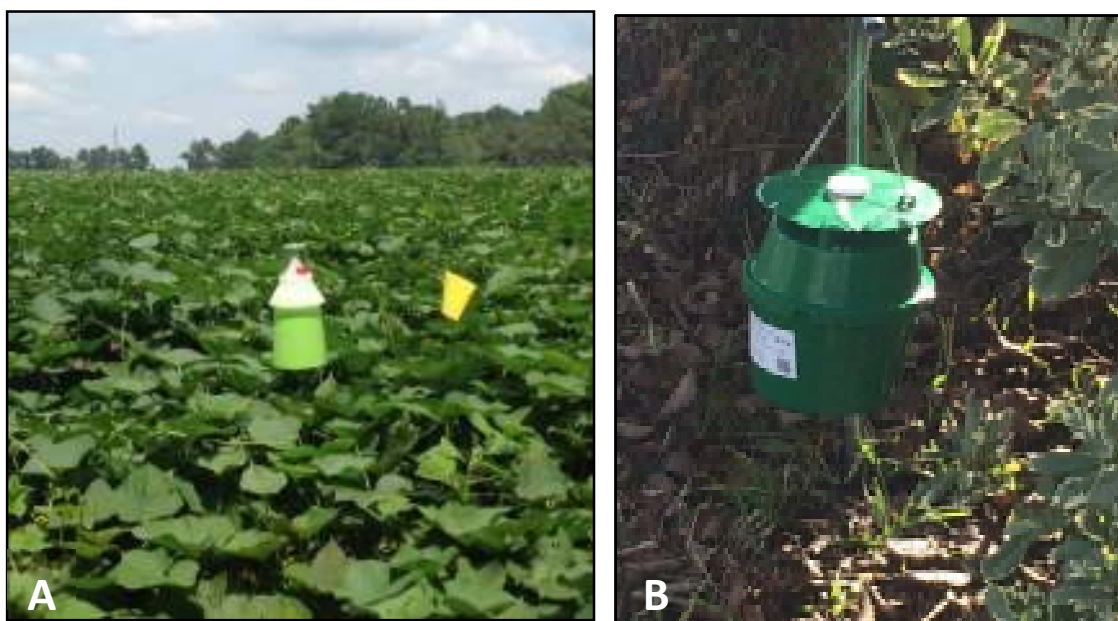


Figure 13 Sweet potato weevil traps.

A) Green boll weevil trap baited with sweet potato weevil lure used to survey sweet potato fields and, **B)** Universal Green Moth Trap used to survey in storage facilities and the NC sweet potato quarantine area.

Sweet Potato Weevil Eradication (Phase 1 – in progress)

NCDA&CS Plant Industry Division was awarded a Specialty Crop Block Grant (USDA Farm Bill 2014) to determine the spatial and temporal distribution of sweet potato weevil populations in the quarantine area of North Carolina with the eventual goal of eradicating the pest entirely from the state. The project began in 2015 with the setup of a detection grid consisting of 398 universal moth traps in a hexagonal grid pattern. Using the results of the 2015 detection grid a delimiting grid consisting of 325 traps was set up in January 2016 and traps were checked weekly from February through the end of the year (Figure 14). 12,708 data points were collected from weekly trap checks. From this information, we improved our knowledge of where the weevil populations are clustered in New Hanover and Brunswick counties.

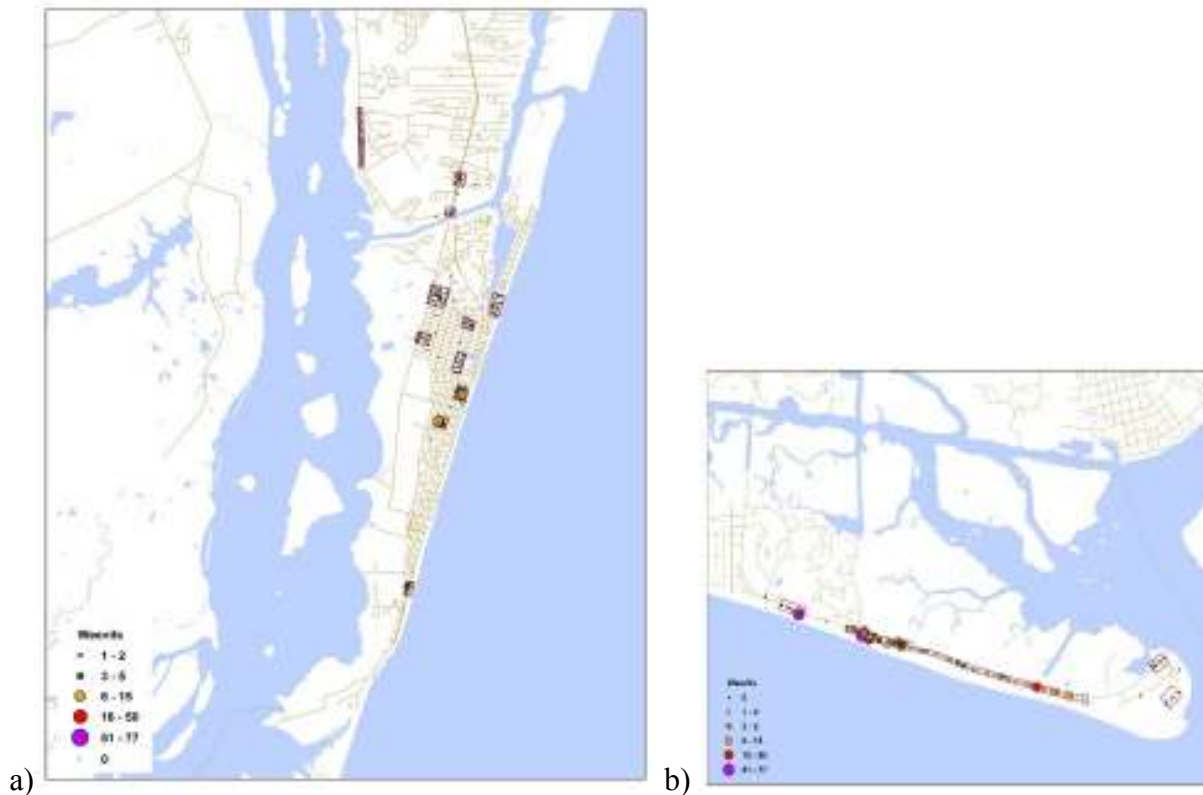


Figure 14 Sweet potato weevil quarantine area delimiting grids.

a) New Hanover County (Carolina and Kure Beaches) and b) Brunswick County (Caswell Beach)

In addition to weekly trapping, we began to map host populations in the quarantine area. Since there are no sweetpotatoes produced in the area, the weevils feed on an alternative host, morning glory (Convolvulaceae). The host mapping project is still ongoing but we plan to use the information collected during this survey coupled with the highly specific data on weevil population hotspots to target areas for IPM treatments (e.g. sterile male releases, biocontrol, pesticides) in order to eradicate this pest from the state. Actual eradication will come in Phase 2 of the project which we plan to initiate sometime in the not-too-distant future.

European Gypsy Moth Program

2015 Gypsy Moth Slow the Spread and Eradication Program

In 2016 NCDA&CS, in cooperation with USDA-APHIS-PPQ, USDA-Forest Service (USFS), and the Slow the Spread (STS) Foundation, carried out an extensive trapping, treatment, regulatory, and alternate life stage survey program aimed at detection and eradication of European gypsy moth (EGM), a major invasive pest of hardwood trees. The program in North Carolina is divided into two different areas, STS and Eradication, as shown in Figure 15.



Figure 15 North Carolina Gypsy Moth Program Boundaries 2016

Trapping

A total of 12,939 traps were set in 95 counties in North Carolina from April to June 2015 and removed from July to September 2015. Traps were baited with disparlure, the female-produced sex pheromone of gypsy moth (2-methyl-7R, 8S-epoxy-octadecane). Trap locations and data were recorded in iPad units. A total of 2,021 adult gypsy moth males were captured in 915 positive traps in North Carolina in 2015. Positive catches were confirmed by the state entomologist and entered into the gypsy moth trapping database at Virginia Tech. Final results of these surveys are shown in Table 8 and Figure 16.

Male moth captures in 2016 were significantly higher than in the last two years, with three distinct pockets of high captures along the Virginia-North Carolina border (Figure 16). Blown-in male moths from a breakout year in Virginia may explain the increase. Six treatments and multiple delimiting grids are proposed for 2017 to follow up in high-capture locations.

Per 2016 USDA-APHIS-PPQ protocol as stipulated in the cooperative agreement (16-8237-0864-CA), trapping surveys were conducted in the Eradication area (all non-STs area) as shown in Figure 15. Delta traps were set in an area-wide grid of 1 trap per 3 kilometers, with some areas being trapped at one trap per 500 or 1000 meters if there was a suspected EGM population. Funding provided by USDA-APHIS-PPQ was used to employ 13 temporary employees, buy the necessary survey supplies (including traps, lures, iPads, and office supplies), and for operational expenses (including fuel and maintenance for survey vehicles). Additionally, funding from USFS was used to hire two temporary employees who monitored traps close to areas treated in 2016 in the Eradication area, purchase supplies, and for operational expenses associated with this work.

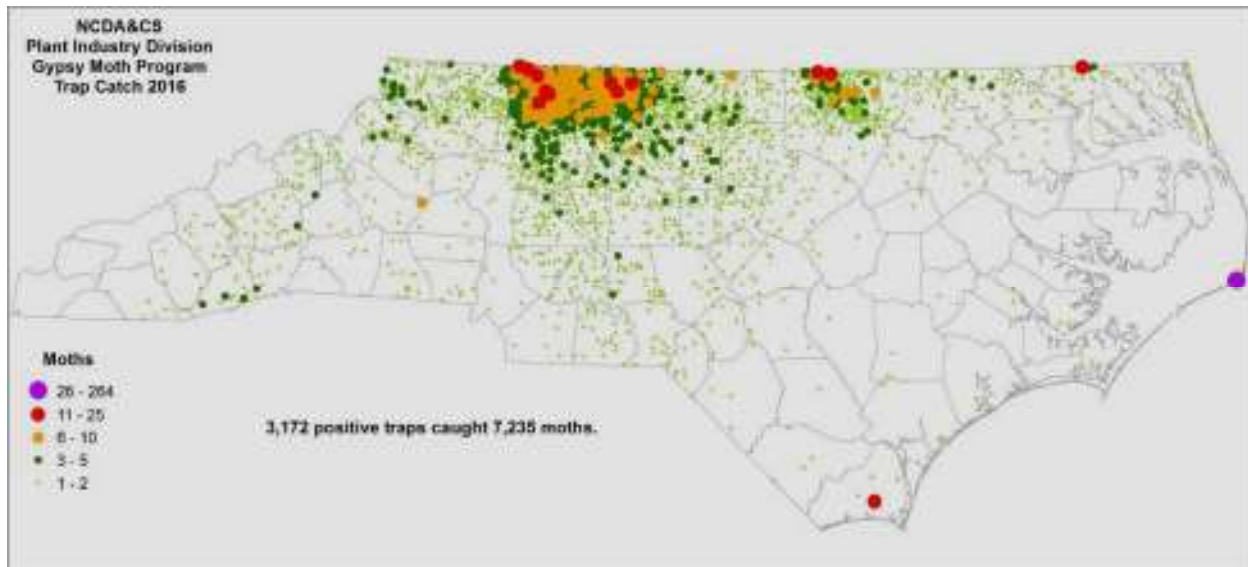


Figure 16 North Carolina gypsy moth trap catches in 2016.

In the STS area, 7 contractors set traps in 25 bid units, according to site data provided by the STS Foundation in cooperation with Virginia Tech. Delta traps were set in an overall grid of 1 trap per 2 kilometers along the northern portion of the STS area; all other portions of the STS area were trapped at a density of 1 trap per 3 kilometers. Locations with high catches the previous year or areas under evaluation from treatments in previous years were surveyed in a 500-meter or 1000-meter grid utilizing either high-density milk carton traps or delta traps.

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Table 8 2015 EGM survey results in North Carolina by county.

County	Total Traps	Total Positive	Total Catch
Alamance	125	53	78
Alexander	77	4	4
Alleghany	157	31	38
Anson	149	25	33
Ashe	240	66	107
Avery	57	8	10
Beaufort	238	2	2
Bertie	309	7	7
Bladen	237	1	1
Brunswick	268	8	31
Buncombe	151	34	43
Burke	170	18	36
Cabarrus	103	20	24
Caldwell	125	21	25
Camden	159	9	9
Carteret	114	3	3
Caswell	334	97	143
Catawba	119	3	3
Chatham	197	55	74
Cherokee	98	1	1
Chowan	89	3	3
Clay	38	0	0
Cleveland	133	13	15
Columbus	238	5	5
Craven	171	3	3
Cumberland	206	6	7
Currituck	239	17	20
Dare	477	55	616
Davidson	153	73	104
Davie	75	53	93
Duplin	234	2	2
Durham	120	22	24
Edgecombe	149	6	6
Forsyth	140	93	221
Franklin	380	26	33
Gaston	105	6	6
Gates	256	41	94
Graham	38	0	0
Granville	395	132	323

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County	Total Traps	Total Positive	Total Catch
Greene	77	0	0
Guilford	202	114	199
Halifax	452	30	34
Harnett	173	8	9
Haywood	97	14	15
Henderson	85	11	18
Hertford	228	17	18
Hoke	103	9	10
Hyde	131	1	1
Iredell	176	20	22
Jackson	104	10	10
Johnston	227	5	6
Jones	115	0	0
Lee	74	10	10
Lenoir	110	2	2
Lincoln	85	3	4
Macon	98	5	6
Madison	108	1	1
Martin	130	2	2
McDowell	91	6	7
Mecklenburg	163	3	3
Mitchell	58	15	17
Montgomery	133	36	43
Moore	125	11	13
Nash	178	9	9
New Hanover	71	1	2
Northampton	360	44	54
Onslow	185	2	2
Orange	206	61	78
Pamlico	93	3	3
Pasquotank	154	1	2
Pender	267	5	6
Perquimans	154	4	4
Person	331	45	56
Pitt	189	0	0
Polk	54	1	2
Randolph	242	70	83
Richmond	119	13	15
Robeson	262	5	5
Rockingham	423	294	856

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County	Total Traps	Total Positive	Total Catch
Rowan	148	44	63
Rutherford	148	4	6
Sampson	266	1	1
Scotland	87	8	9
Stanly	114	28	30
Stokes	350	317	1238
Surry	371	281	1086
Swain	39	0	0
Transylvania	55	13	22
Tyrrell	86	0	0
Union	182	6	6
Vance	558	190	331
Wake	248	19	19
Warren	574	114	161
Washington	97	0	0
Watauga	97	36	56
Wayne	169	0	0
Wilkes	309	98	125
Wilson	116	3	3
Yadkin	115	81	184
Yancey	72	16	21
Total	17,897	3,172	7,235

Treatments

Four mating disruption treatments were conducted in North Carolina in 2015, all in cooperation with the USDA-Forest Service in the STS area (Figure 17 and Table 9). Each site received one dose of Disrupt II pheromone flakes at a rate of 6 grams per acre. These sites will be trapped in 2017 to determine the efficacy of the treatments. Four sites within the STS area were treated either once or twice aerially with *Bacillus thuringiensis* var. *kurstaki* (Btk), due to the presence of alternate life stages at those sites, for a total of 5,372 acres in that area. In the Eradication area one location – Buxton, in Dare County – was treated twice aerially with Gypchek (totaling 2,956 acres), a product that contains a gypsy moth-specific virus. At that same site two small ground treatments with Btk were also performed to prevent a repeat defoliation at that site (totaling 60 acres). Two other sites in the Eradication area in Pender and Jones/Onslow Counties were treated twice aerially with Btk (totaling 3,850 acres). A total of 35,019 acres were treated for gypsy moth in North Carolina in 2016.

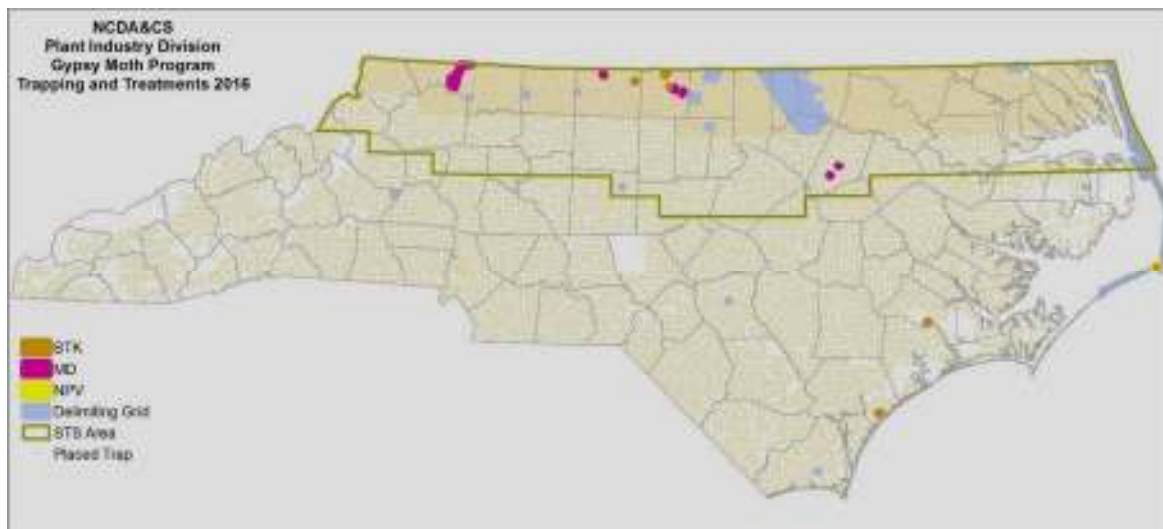


Figure 17 2015 EGM treatment sites (red) along with delimiting grids and all other traps set.

Table 9 2016 gypsy moth mating disruption treatment rate, site location, and acreage.
 (For product, MD = mating disruption and Btk = *Bacillus thuringiensis* var. *kurstaki*.)

Site name	County	Product	Number of Applications	Acres in Block	Total Acres Treated at Site
Roaring Gap	Alleghany/Stokes	MD	1	17,811	17,811
Leasburg	Caswell	MD	1	1,390	1,390
Leasburg	Caswell	Btk	1	448	448
Ringgold	Caswell	Btk	2	1,700	3,400
Yanceyville	Caswell	Btk	2	186	372
Yanceyville	Caswell	MD	1	1,785	1,785
Buxton	Dave	Gypchek	2	1,478	2,956
Buxton	Dare	Btk ground	2	30	60
Maysville	Jones/Onslow	Btk	2	940	1,880
Nashville	Nash	MD	1	440	440
Spring Hope	Nash	MD	1	530	530
Topsail	Pender	Btk	2	985	1,970
Northwest Eden	Rockingham	MD	1	825	825
Ruffin	Rockingham	Btk	2	576	1,152

Regulatory

The gypsy moth program also seeks to mitigate the risk of artificial introduction and spread through a comprehensive regulatory program. An area that is generally infested is quarantined so that the movement of certain high-risk articles, such as logs, outdoor household articles, and nursery plants, is strategically restricted per USDA-APHIS-PPQ regulations. In North Carolina, Currituck and a small portion of Dare Counties were quarantined in 1988. A map of the North Carolina gypsy moth quarantine area is shown in Figure 18.

Regulated articles may be moved from quarantined to non-quarantined areas if the appropriate personnel undergo training and submit to the stipulations of a Compliance Agreement with NCDA&CS. These compliance agreements require inspection and/or treatment of articles to ensure that they are free of gypsy moth life stages. A number of businesses and individuals received training for new staff and several new Compliance Agreements were issued.

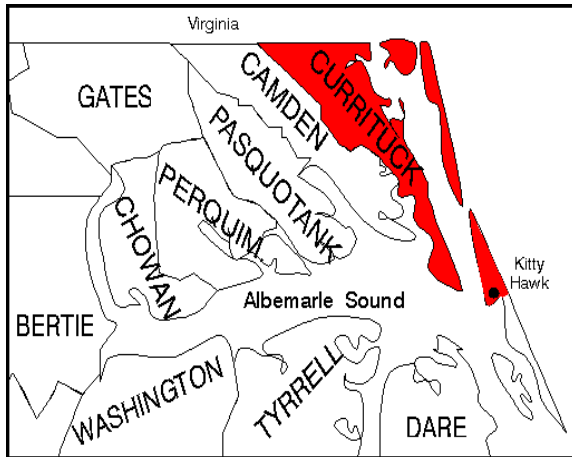


Figure 18 Gypsy moth quarantine in North Carolina shown in red.

Public education efforts are also an important part of the regulatory program. Staff visits NC Cooperative Extension and NC Forest Service offices to update county personnel on program changes. Also, program personnel monitor all high-risk locations in the STS program area by the placement and removal of traps.

The regulatory program is enduring a time of transition as USDA-APHIS-PPQ, the federal granting agency, has steadily decreased gypsy moth regulatory grants. NCDA&CS' dedicated regulatory position no longer exists, though the person who previously held that post has assumed different responsibilities on our staff and remains able to assist with gypsy moth regulatory tasks. The future character of the program will be determined in part by USDA-APHIS-PPQ funding for this program.

Blueberry Export Certification Program

The blueberry maggot (Figure 19; *Rhagoletis mendax*; BBM) is a serious pest of both lowbush and highbush blueberries. Infestations of this pest lead to unmarketable berries, reductions in yield, and increased production costs. The maggot is native to eastern North America and is found in the eastern United States, including North Carolina. While native to Nova Scotia, New Brunswick, and Prince Edward Island, the pest was detected in Ontario and Quebec in the mid-1990s—two regions where the maggot had not previously been known to exist. As a result, Canada regulates *R. mendax* to prevent spread of BBM into provinces that are currently free of this pest. The Blueberry Certification Program (BCP) was initiated by the Canadian Food Inspection Agency (CFIA) in 1999 to facilitate the movement of fresh blueberries while managing the risk of further spread of the blueberry maggot into non-infested areas of Canada.

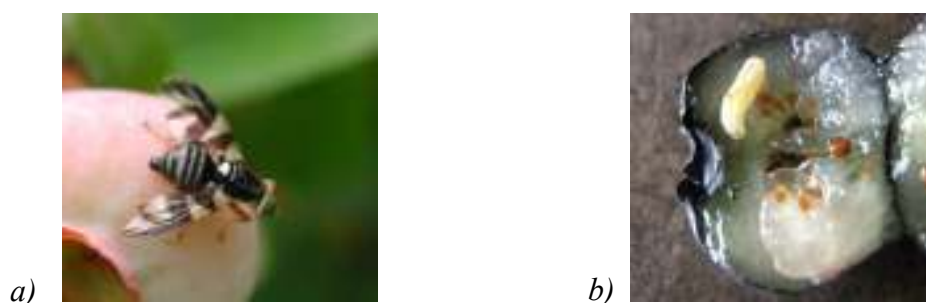


Figure 19 Blueberry maggot (*Rhagoletis mendax*):
a) adult; b) larva inside blueberry (Photos by Rufus Isaacs, MSU)

In North Carolina, we currently have 53 blueberry farms located in four southeastern NC counties (Bladen, Duplin, Pender, and Sampson) participating in the Blueberry Certification Program. In 2016, two new farms were added to the program and two were removed from the program, keeping the total the same from 2015 to 2016. In previous years, new certificates were ordered and printed through Correction Enterprises at a cost of \$353.64/3000 certificates. This year we switched to using the NCDA&CS print shop at a cost of \$7.97/3000 certificates. In addition to monetary savings, we were able to have new certificates ordered, printed, and delivered within two weeks as opposed to the previous six-week timeframe.

On May 13, 2016, we mailed out the annual blueberry maggot flight letter informing all growers in the program that they should begin their internal audits. In past years, growers have utilized a hot water method to test for the presence of BBM, but as of June 2015, all growers are required to perform a brown sugar or salt flotation test on their berries every three days starting from when they receive their flight letter until they are done packing and shipping for the season. The flotation test involves soaking two pints of gently crushed berries in either a sugar or salt solution for 10 minutes to observe whether any maggots float to the surface (Figure 20; the complete method can be found at <http://www.ncagr.gov/plantindustry/Plant/entomology/BlueberryCertificationProgram.htm>).

Beginning the first week of June, NCDA&CS Plant Protection personnel began traveling to each farm to perform the annual regulatory audit. The NCDA&CS audit consists of performing the flotation test and checking the calendar spray treatment and/or trapping records (if utilizing IPM) to ensure the growers are following the CFIA BCP regulations. Every single grower in the program elected to use the salt solution

(as opposed to the brown sugar solution). The results were negative for all audits performed (both internal and regulatory). Four of the farms had no crop this year as a result of a late freeze. One farm finished their packing for the season before NCDA&CS personnel arrived to perform the audit so their records were copied for our files, but no regulatory audit was performed.

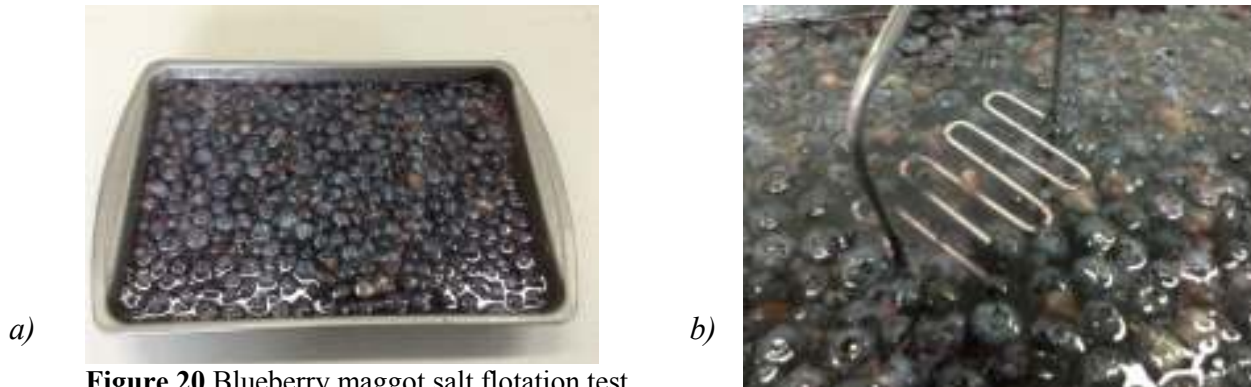


Figure 20 Blueberry maggot salt flotation test

a) blueberries soaking in salt water solution for 10 minutes; *b)* close-up of flotation test showing potato masher used to gently crush berries. (Photos by Whitney Swink, NCDA&CS)

In the past we have utilized paper forms for recording information for the regulatory audits. This year, we switched to using a fillable form on the iPads. This improved the rate at which the data (spray records, internal audit dates, etc.) could be recorded as well as increased organization as the forms could be emailed immediately upon completion of each regulatory audit ensuring all of the records are kept in one place.

In 2017 the plan is to refine the BCP application that each grower is required to submit each year. In addition to the name and contact information of the owner of the establishment, applicants will be requested to provide the name and contact information of the person who will be performing the internal audits. This will help improve communication and assist us with locating information that may be missing from the internal audit forms. One issue that occurred this past year was that some growers aren't keeping their spray records with their internal audit records despite the fact that the audit forms require this information. This led to some running around to track down the spray records. We will continue to stress the importance/necessity of keeping this information together and having it readily available upon request. We will have a table at the 2017 Blueberry Open House & Trade Show to provide information about the Blueberry Certification Program and the role NCDA&CS plays in assisting growers in getting their blueberries safely and smoothly to Canada.

Walnut Twig Beetle Program (Thousands Cankers Disease of Walnuts)

The walnut twig beetle (*Pityophthorus juglandis*) is a vector of a serious disease of forest trees affecting primarily black walnuts (*Juglans nigra*) and butternuts (*Juglans cinerea*) called thousand cankers disease (*Geosmithia morbida*; TCD). Our plant pathologist, Leah Roberts, currently runs the TCD program and the work done on the program is covered in the plant pathology section of the NCDACS-PID-PPS annual report.

Imported Fire Ant Program

The Imported Fire Ant (*Solenopsis invicta*) (IFA) continues to be a serious pest in the southern United States with infestations occurring in eleven states. North Carolina is on the leading edge of the expanding range of fire ants. Currently, 74 of North Carolina's 100 counties are either partially or entirely infested. NCDA&CS' objective is to prevent the artificial spread of IFA from infested areas to non-infested areas through regulatory actions.

Surveys and Blitzes

Drive-by surveys were conducted in 20 counties in NC (Table 10). Data was collected using GPS units and included new IFA mounds and established sites. The category "Absent" was also added and indicates sites with no mounds reported. It was used as a way to show the areas surveyed in all counties (negative controls).

As a result of surveys conducted in 2015 and 2016 within the state, the following counties were quarantined at the end of 2016: Burke (partial), Catawba (entire), Northampton (entire), Rowan (entire) and Rutherford (entire). Catawba, Northampton, Rowan, and Rutherford were previously under partial quarantine. Additional areas will be considered for quarantine expansion in 2017 utilizing the data collected from the 2016 surveys.

Blitzes were also conducted, as part of the IFA regulatory program in NC, in four locations across the state to enforce that operations moving regulated articles outside the quarantine area in NC are in compliance with federal and state regulations. A total of 40 blitzes were conducted during Spring and Fall 2016 from March 1 to March 30 and August 30 to September 28, respectively, at the weigh stations in Halifax (I-95 corridor in Halifax County), Lumberton (I-95 corridor in Robeson County), Mt. Airy (I-74 Corridor in Surry County), and Hendersonville (I-26 corridor in Henderson County) (Table 11). One hundred eighteen (118) were stopped, of which 67 were stopped at the Halifax weigh station, 38 at the Lumberton weigh station, 6 at the Mount Airy station, and 7 at the Hendersonville weigh station. Drivers were asked if they were transporting IFA regulated articles. Soil samples from 30 vehicles were collected and processed from regulated articles such as potted plant containers and trees, and the samples were sent for chemical analysis (NCDA&CS Food and Drug Protection Division Laboratory) to determine the levels of bifenthrin or any other approved pesticides as required by the federal and state regulations. All samples but one showed detectable levels of bifenthrin, chlorpyrifos, diazinon, fenoxycarb, fipronil, hydramethylenon, methoprene, pyriproxyfen and/or tefluthrin in compliance with the levels required by state and/or federal regulations. PPQ personnel assisted in all but one of these blitzes.

Table 10 2016 IFA Survey Results

County	Areas Surveyed	Regulatory Action Recommended (*)	Absent	Established sites	New observation	Total
Alamance	North of I-40 to county line	No action	998		9	1007
Alexander	5 mile strip from the 2015 quarantine line	No action	2			2
Buncombe	Entire county	No action	135			135
Catawba	5 mile strip from the 2015 quarantine line	Expansion 1/17	36	4	3	43
Davie	5 mile strip from the 2015 quarantine line	No action	13		4	17
Granville	North of quarantine line to VA border	No action	223		20	243
Guilford	North of I-40 to county line	No action	434		1	435
Haywood	Entire county	No action	160			160
Henderson	Entire county	No action	9	1		10
Iredell	North of I-40 to county line	No action	37		9	46
Jackson	Entire county	No action	197	2	2	201
McDowell	Entire county	No action	49			49
Orange	North of I-40 to county line	No action	293		3	296
Person	E/SE of Hwy 49	No action	273			273
Rowan	5 mile strip from the 2015 quarantine line	Expansion 1/17	40		8	48
Rutherford	From 2015 quarantine line to county line	Expansion 1/17	11			11
Swain	Entire county	No action	101	1		102
Transylvania	Entire county	No action	34	1		35
Vance	North of quarantine line to VA border	No action	343		25	368
Warren	North of quarantine line to VA border	Possible addition 1/18	328	2	76	406
Total			3716	11	160	3887

Table 11 2016 NC Imported Fire Ant blitzes summary

Date	Location	Trucks stopped	Soil samples collected
1 March 2016	Halifax weigh station	11	4
2 March 2016	Halifax weigh station	11	5
8 March 2016	Halifax weigh station	14	8
9 March 2016	Halifax weigh station	9	2
15 March 2016	Lumberton weigh station	13	3
16 March 2016	Lumberton weigh station	8	2
22 March 2016	Mt Airy weigh station	3	0
23 March 2016	Mt Airy weigh station	2	0
29 March 2016	Hendersonville weigh station	2	0
30 March 2016	Hendersonville weigh station	2	1
30 August 2016	Halifax weigh station	5	0
31 August 2016	Halifax weigh station	7	3
6 September 2016	Halifax weigh station	7	1
7 September 2016	Halifax weigh station	3	1
13 September 2016	Lumberton weigh station	9	0
14 September 2016	Lumberton weigh station	8	0
20 September 2016	Mt. Airy weigh station	1	0
21 September 2016	Mt. Airy weigh station	0	0
27 September 2016	Hendersonville weigh station	1	0
28 September 2016	Hendersonville weigh station	2	0
Totals:	40¹	118	30

¹Corresponds to 20 days and two blitzes per day.

Cotton Boll Weevil Program

Field surveys for the cotton boll weevil (*Anthonomus grandis*) were coordinated and carried out by the Boll Weevil Eradication Foundation of North Carolina. In 2016, a total of 274,202 acres were reported in 50 North Carolina counties (Table 12). NCDA&CS Plant Industry staff surveyed cotton gins (n=51) and cotton processing facilities in 30 counties (Table 13) using conventional cotton boll weevil traps, similar to those used for sweet potato weevil field surveys. Traps were baited with a male specific sex pheromone and checked once a month. **No boll weevils were found in North Carolina during the 2016 growing season.**

Table 12. 2016 reported cotton acreage in North Carolina by county.

County	Acreage	County	Acreage	County	Acreage
Anson	2,575	Greene	755	928	928
Beaufort	7,270	Halifax	39,185	5,640	5,640
Bertie	15,526	Harnett	5,639	5,403	5,403
Bladen	10,592	Hertford	7,839	2,663	2,663
Brunswick	335	Hoke	6,505	6,065	6,065
Cabarrus	295	Hyde	8,593	329	329
Camden	136	Johnston	2,619	12,128	12,128
Carteret	312	Jones	4,696	1,998	1,998
Chowan	5,765	Lee	285	10,196	10,196
Columbus	1,375	Lenoir	3,358	4,733	4,733
Craven	1,827	Lincoln	126	363	363
Cumberland	3,067	Martin	22,848	343	343
Davidson	350	Montgomery	231	523	523
Duplin	1,620	Nash	1,956	5,219	5,219
Edgecombe	9,831	Northampton	32,778	2,945	2,945
Franklin	447	Onslow	1,601	3,915	3,915
Gates	9,485	Pasquotank	988		
				Total	274,203

Table 13. 2016 Number of cotton gin surveyed by county.

County	Gins	County	Gins	County	Gins
Anson	1	Greene	1	Perquimans	1
Beaufort	1	Halifax	8	Pitt	3
Bertie	2	Harnett	2	Robeson	2
Bladen	1	Hertford	1	Rutherford	1
Chatham	1	Hyde	1	Sampson	2
Chowan	1	Jones	1	Scotland	1
Cleveland	2	Lenoir	3	Stanly	1
Edgecombe	1	Martin	1	Washington	1
Gaston	1	Nash	1	Wayne	2
Gates	1	Northampton	5	Wilson	1

Movement of Live Insects for Research, Commercial or Educational Purposes

The Entomological Programs Specialist evaluated 106 federal applications for PPQ 526 e-Permits in 2016. No permits were rejected this year. The large number of applications to move insects into North Carolina reflects the continued strong market in entomological research, commerce, and education in the state conducted by our public and private institutions.

Table 14 Entomological quarantine summary for North Carolina in 2016.

Regulatory Species	Quarantines as of December 2016
Emerald Ash Borer (<i>Agrilus planipennis</i>)	The entire state of North Carolina was placed under quarantine in 2015.
Gypsy Moth (<i>Lymantria dispar</i>)	Currituck County. Quarantine area remained unchanged relative to 2015.
Imported Fire Ant (<i>Solenopsis invicta</i>)	The quarantine was expanded to include the entirety of Catawba, Northampton, Rowan, and Rutherford counties and a portion of Burke County. A total of 74 counties are under entire or partial quarantine in NC.
Sweetpotato Weevil (<i>Cylas formicarius</i>)	Coastal areas of Brunswick (Caswell Beach) and New Hanover (Carolina Beach and Kure Beach) counties.
Walnut Twig Beetle (<i>Pityophthorus juglandis</i>)	Haywood County. Quarantine area remained unchanged relative to 2015.

Nursery Certification Program

NCDA&CS' Plant Protection Specialists inspected 4,250 nursery dealers and nurseries during the 2016 season. Forty (40) Stop Sale/Movement notices were issued to prevent the sale of infected or prohibited plants. These plants were either treated, destroyed, or released after lab testing.

A license issued by the NCDA&CS is required by any person selling nursery stock in North Carolina. Nursery stock is defined as "all wild or cultivated plants or parts thereof, trees, shrubs, vines, bulbous plants and roots, grafts, scions and buds." Excluded in North Carolina's definition of nursery stock are "annual plants; cut flowers; tree, field, vegetable, flower or other true seeds; decorative plants or plant parts without roots not intended for propagation; and perennial plants intended for indoor use that are produced in North Carolina." A *nursery license* is required for any person growing and selling nursery stock whereas a *nursery dealer license* is required for any person obtaining and re-selling nursery stock. These licenses certify that plant material has been inspected for and is apparently free from potentially harmful quarantine pests and must be renewed yearly.

The NCDA&CS Plant Protection Section licensed 1,293 nurseries and 2,957 nursery dealers during the 2016 calendar year (Table 15). Of the 1,293 nurseries, 642 were registered nurseries and 651 were certified nurseries. A *registered nursery* has less than one acre of nursery stock and does not sell outside the state. A *certified nursery* has one or more acres of nursery stock and/or sells outside the state.

The data show a slight increase in the number of nurseries and the number of acres that were certified. This increase is believed to be a reflection of the improving economy and its impact on the nursery industry. The nursery dealer industry remained relatively unchanged in the state continuing to offer quality nursery stock to consumers. The increases in nursery production as well as nursery dealer stability indicates the strength and staying power of North Carolina's nursery industry.

Table 15 Number of North Carolina nursery and nursery dealer licenses by year^w

Calendar Year	Number of Licenses by Category			Total Number of Licenses	
	Registered Nursery ^x	Certified Nursery ^y	Nursery Dealer ^z	Nurseries (Registered & Certified)	Nurseries & Dealers
2013	515	548	2,821	1,063	3,884
2014	590	654	2,782	1,244	4,026
2015	594	612	3,188	1,206	4,394
2016	642	651	2,957	1,293	4,250

^wData based on receipt of license fees.

^xRegistered nursery – a location with less than once acre of nursery stock with no sales outside the state.

^yCertified nursery – a location with one or more acres of nursery stock and/or sales outside the state.

^zNursery dealer – a location where nursery stock is sold, usually to the end user, but not actually grown.

The primary objective of Plant Industry's Nursery Program is to facilitate the movement of nursery stock while preventing the introduction and spread of quarantine plant pests into and within North Carolina. The movement of infested nursery stock represents one of the ways plant pests may be moved from one location to another and has the potential to directly impact both wholesale and retail nursery operations. North Carolina works to prevent such outbreaks by coordinating with other states and the nursery industry to bring awareness of threats to the state.

Stop sale/movement notices are issued when high levels of pests and/or prohibited plants are noted. Plants can either be treated and/or destroyed when a stop sale/movement notice is issued. Plants can be released for sale/movement if testing of the material confirms they are free of the suspected pest(s). During calendar year 2015, forty (40) stop sale/movement notices were issued.

Phytosanitary Certification Program/ 2016 Export Certification Program

Within the Phytosanitary and Export Certification Program, Plant Protection Specialists issue phytosanitary certificates to growers and/or brokers to facilitate movement of agricultural commodities to other states and to other countries. Phytosanitary certificates indicate that inspections and other specific requirements of the importing states or countries have been met. State certificates are used for movement within the United States, and federal certificates are required for movement to another country. Countries and states vary greatly in what they require for various types of commodities such that careful research and interpretation of requirements are needed for each request for phytosanitary certification.

A phytosanitary certificate provides documentation that a plant, plant part, or plant-based product has been inspected and is apparently free of harmful pests. Each state and country has very specific import phytosanitary requirements that are tailored to protect their agricultural industries and natural environment from potentially harmful pests.

The NCDA&CS Plant Protection and Export Certification Specialists facilitate interstate and international movement of plants, plant parts, and plant-based products by issuing both state and federal phytosanitary certificates to North Carolina growers and brokers. State and federal phytosanitary certificates are issued for interstate and international movement, respectively. The NCDA&CS is responsible for implementing the state export program, while the USDA is responsible for implementing the federal export program. However, the NCDA&CS works in collaboration with the USDA to issue federal phytosanitary certificates to support international export of plant-based products from North Carolina.

Primary use of the USDA PCIT (Phytosanitary Certificate Issuance and Tracking) System to issue federal certificates began in October 2009. The number of federal and state phytosanitary certificates issued using the PCIT system is included in Table 16. In 2016, NCDA&CS staff issued 7,356 federal phytosanitary certificates and 703 state phytosanitary certificates. The number of federal phytosanitary certificates issued in 2016 represented a 9.1% increase from 2015 figures while the number of state phytosanitary certificates issued represented a 25.3% increase from the previous year. Federal certificates were issued for the movement of commodities to 91 countries, while state certificates were issued for 33 states, Puerto Rico, and the Virgin Islands. The majority of phytosanitary certificates issued were for lumber, tobacco, cotton, cotton seed, Christmas trees, peanuts, nursery and greenhouse plants, sweet potatoes, and sweet potato cuttings.

Table 16 Number of phytosanitary certificates issued through the PCIT¹ system²

Fiscal Year	Federal				State
	Plant or Plant Part	Re-export	Processed Plant Product	Total	Total
2009/2010 ³	1,759	24	0	1,783	205
2010/2011	2,781	21	0	2,808	323
2011/2012	4,221	13	18	4,252	206
CY 2013 ⁴	5,830	15	134	6,658	412
CY 2014	6,980	32	172	7,184	348
CY 2015	6,560	21	162	6,743	561
CY 2016	7,140	17	199	7,356	703

¹ PCIT = Phytosanitary Certificate Issuance and Tracking (USDA web based application)² Use of PCIT began in October 2009³ Fiscal year data⁴ Calendar year data

Plant Conservation Program

North Carolina Plant Conservation Board

The Plant Conservation Program (PCP) meets quarterly with members of the NC Plant Conservation Board whose seven members are appointed by the Governor and the Commissioner of Agriculture. Members in 2016 included: Kathy Schlosser (chair) Les Hunter, Steve Henson, Alexander Krings, David Hyatt, Jonathan Lanier, and Peter White.

Peter White of the NC Botanical Garden retired at the end of 2014; he will continue to serve pending a Governor-appointed replacement of an NC Botanical Garden representative. Damon Waitt, the new Director of the NC Botanical Garden attended NC Plant Conservation Board meetings in an unofficial capacity in 2016.

In 2016, the Board completed a review of their rules and regulations (2 NCAC 48F) as per the Rules Review Commission. Each of the twelve rules were determined “Necessary without substantive public interest” in July. These determinations were sent for public comment, but received none. A final determination was made for each of the twelve rules as “Necessary without substantive public interest” in November.

The Board also completed and approved a policy titled Policies & Practices of PCP which describes the authority to and process for PCP to acquire land for the protection of native plant species in North Carolina. They also approved an appendix to this policy drafted by the Scientific Committee regarding introductions, reintroductions, and augmentations of plants on PCP Preserves.

North Carolina Plant Conservation Scientific Committee

PCP meets regularly with members of the NC Plant Conservation Scientific Committee. This seven member committee consists, primarily, of positions designated to the committee by law. Members include Alan Weakley (chair), Dennis Niemeyer, Richard Braham, Johnny Randall, Hervey McIver, Laura Robinson and Jerry Reynolds. Jerry Reynolds replaced long-time committee member and former chair Alvin Braswell in 2016 following Alvin’s retirement from the NC Museum of Science.

The Committee continued work on updating the imperiled plant list following procedures and protocols established during the last update in 2008. The Committee will suggest additions, deletions, and technical changes once PCP staff completes necessary analyses and ensures a thorough review of any changes to trends and threats of individual imperiled species. The committee finalized an Appendix to the Policies & Practices of PCP which outlines the Introduction, Reintroduction, and Augmentation Policy for Practices on PCP Preserves. These guidelines include staff-level decisions such as augmentation of existing imperiled plant occurrences and instances where Committee or Board action is necessary. The Committee also commenced work on developing an Appendix B to the “Practices” document which would include a policy for public access to PCP Preserves.

Plant Conservation Preserve System

Plant Conservation Preserves are lands permanently protected for the conservation of North Carolina’s native flora and their habitats. These Preserves are the only state-managed lands selected and designed specifically for plant conservation purposes. The Preserve system consists of 24 Preserves distributed across North Carolina (Figure 21). Although no new Preserves were added in 2016, additional acreage

was added to two Preserves: Tater Hill and Cedar Mountain Bog Preserves. Two properties (Suther Prairie and McIntosh Bay) are pending acquisition into the Preserve System (Figure 21). The former is a project being undertaken by the Cabarrus County Soil and Water Conservation District with the plan to transfer the property to PCP for permanent protection. The latter is a collaborative project between The Nature Conservancy (TNC) and PCP whereby TNC has purchased the property from the private land owner and is in the process of conducting restoration activities before selling the property to PCP. Both of these projects are expected to close in 2017.

Although the official property closing transaction was executed in the end of 2015, the Caraway Preserve had a ribbon-cutting dedication ceremony in April of 2016 to thank the many donors who contributed to the protection of this property.



Figure 21 Plant conservation preserve system

Preserve Field Trips

PCP staff's outreach efforts included public lectures, preserve field trips, and volunteer workdays. Due to concerns about resource damage and plant poaching, PCP conducts guided preserve tours open to the public. Access by researchers and educators is by permit only. Each trip provides participants the opportunity to observe rare plants, while also learning more about land management and ecological stewardship. Staff scheduled tours on preserves in 2016 and responded to various requests for tours and public presentations. Six guided tours were conducted at Caraway, Butner Cedar Glade, Tater Hill, Eno Diabase Sill, Hebron Road, and Redlair reaching citizens across the state. Three additional scheduled preserve tours were unfortunately cancelled due to bad weather at Cedar Cliff Mountain, Paddy Mountain, and Boiling Spring Lakes Preserves.

Land Conservation Funding

PCP staff did not prepare grant applications to the Clean Water Management Trust Fund (CWMTF) in 2016. However, we were represented in partner applications for fee simple purchases that would be transferred to PCP as new Preserves or additions to Preserves. In 2015, PCP submitted five applications to CWMTF and received funds for each of them. In 2016, PCP staff worked closely with the NCDA&CS Property and Construction Office to carry out each of these contracts with closings occurring at Cedar Mountain Bog and progress made on each of the remaining contracts. Active contracts in 2016 include:

- Additional property acquired at Bat Fork Bog Preserve (Henderson Co.)
- Additional property acquired at Paddy Mountain Preserve (Ashe Co.) contract anticipated fully executed in early 2017
- Additional property acquired at Cedar Mountain Bog Preserve (Transylvania Co.)
- Boundary adjustment at Tater Hill Preserve (Watauga Co.) contract anticipated fully executed in early 2017
- New preserve acquisition at McIntosh Bays (Scotland Co.)
- Cabarrus Soil & Water Conservation District (CSWCD) submitted an application to CWMTF to acquire Suther Prairie (Cabarrus Co.). The application was successful and closing is expected in early 2017.

United States Fish & Wildlife Service (USFWS) Partnership

The Plant Conservation Program and USFWS continued a long-standing cooperative agreement related to the recovery of endangered and threatened species in North Carolina. Grant funds obtained under this cooperative agreement provide critical funds to North Carolina each year. This funding covers the program's research specialist position. A portion of the remaining funds support PCP temporary employees for part of the year. The funding from this partnership supports imperiled plant monitoring, preserve management targeted towards federally-listed plant species, and regulatory programs including protected plant permit evaluation and issuance.

Recovery Lands

USFWS annually offers its Recovery Land Acquisition (RLA) to cooperating states, this regional and national competition awards funds to high priority conservation projects. In 2016, PCP was awarded funding for two applications submitted in 2015: "North Carolina Mountain Bog Expansion – Swamp Pink & Bunched Arrowhead Recovery at Bat Fork Bog, Henderson County, North Carolina," and "Protection of North Carolina's only Canby's Dropwort (*Oxypolis canbyi*) site McIntosh Bays – Scotland County, North Carolina." These funds supply necessary matching funds to our CWMTF applications for these same two projects.

Table 17 Plant Conservation Program RLA Projects

Project Title	Existing Preserve	Federal RLA \$	State CWMTF \$	Additional Match \$	Total	acres
Bat Fork Bog	yes	\$41,747	\$36,900	--	\$78,646	7.6
McIntosh Bays	no	\$37,479	\$236,356	\$251,865	\$525,700	260
Totals		\$79, 226	\$273,256		\$604,346	267.6

Partnership and Outreach Projects

The Plant Conservation Program is a member of several statewide or regional conservation partnerships and staff participates in these partnerships as time allows. The PCP has also continued to work closely in partnership with conservation organizations and land trusts across the state in land acquisition and management as well as regional consortiums such as the Bog Learning Network and Cape Fear Arch. Also of note, PCP has expanded its partnerships with the NC Museum of Natural Science, the NCDA Research Stations, and the NC Forest Service offices and personnel around the state.

In addition, staff regularly reaches out to the public with special presentations and by filling information requests. In 2016, staff gave presentations from Transylvania County to Tyrell County for groups such as the NC Herpetological Society, neighborhood natural history groups, Native Plant Society, NC Botanical Garden, and for the Friends of Plant Conservation programs.

PCP staff supported and helped plan the Rare Plant Conservation Discussion Meeting in March, cohosted by the NC Botanical Garden and the NC Zoo. These meetings provide a venue for presentation of new research as well as to hold discussions and pose questions regarding rare plants. These meetings are attended by faculty and students of multiple universities as well as staff from numerous state and federal agencies and provides a good opportunity for PCP to keep current and possible partners abreast of important news related to PCP.

Lesley Starke represented PCP at the first Southeastern Partners in Plant Conservation Conference (SePPCon) in November where she learned about additional funding and regional partnership opportunities available to our program.

Regulatory Programs

The Program is responsible for the protection and conservation of 419 plant species across NC, of which 27 are also federally listed. Staff meets quarterly with an interagency panel to review permit requests for projects affecting these protected plant species. PCP staff continues to review requests for permits from individuals or institutions requesting to move or collect protected plants, including all state and federally listed plant species. This permit requirement applies to transplant and rescue projects, nurseries which propagate and sell protected species, public educational exhibits, as well as many scientific research projects. The review process incorporates input from the US Fish and Wildlife Service and NC Natural Heritage Program. Sixteen protected plant permits were issued and several additional requests were evaluated. PCP works with the Plant Protection Section to issue Certificates of Origin for protected plant species being propagated for sale as part of the nursery inspection process carried out by inspection specialists.

- *Venus Flytrap*

No new projects involving Venus Flytraps were begun in 2016. PCP staff continued to monitor repatriated plants on PCP Preserve land which had been confiscated from poachers. The USFWS was petitioned by a private individual in 2016 to list this species federally. PCP was not involved in this petition process but became aware of it in collaboration with USFWS.

- *Ginseng*

American Ginseng harvest and exports from North Carolina continued under regulations adopted by the NC Plant Conservation Board. Without monitoring by PCP, harvest and export from North Carolina will not be allowed by federal authorities who have listed this plant under the Convention on International Trade in Endangered Species (CITES). The harvest season for American ginseng is September 1st through December 31st. The buying season for wild or wild-simulated green ginseng is September 1st through March 31st. The buying season for wild or wild-simulated dry ginseng is September 15th through March 31st.



Figure 22 American ginseng root

NCDA&CS certified over 8,400 pounds of wild collected ginseng during 2016: 8,418 pounds Dry/Wild; 1 pounds Green/Cultivated representing 25 North Carolina counties. A total of 58 ginseng dealer license permits were issued during the 2015- 2016 season, an increase in almost 20 licenses above the previous year.

- *Galax*

The sale of wild-collected Galax (*Galax urceolata*) is regulated in North Carolina within a stated buying season which prohibits harvest during the early growing season to allow for new leaves to emerge and grow. Similarly, the US Forest Service which allows for this plant to be harvested from some national forests, has a similar harvest ban during the early growing season. In an effort to align these two seasons to eliminate confusion, the PCP Board changed the state buying season to match that of the USFS. Effective January 20, 2016, Galax (*Galax urceolata*) may only be legally bought or sold during the buying season of June 15th through April 15th.

PLANT CONSERVATION PRESERVE MANAGEMENT & MONITORING ACTIVITIES

The Program continues striving to manage Preserves for the benefit of the rare plant species and habitats present on these sites and to conduct sufficiently detailed monitoring to determine the status of rare species at these sites. Some examples are as follows:

Preserve Management Highlights

- ***General***

Prescribed burning is one of the most pressing management needs across the Preserve system and around the state to enhance rare species populations and improve habitats for these species. Following new procedures effective in 2014, staff were able to conduct 14 prescribed burns with the direct assistance of the NCFS during this past year and continue to be responsible for all phases of burn planning and preparation as well as mop-up after the burns were conducted. Of note, one of these burns was the first recorded burn in a particular burn unit in the southern Piedmont with a second notable burn as a first for PCP after taking ownership and management of a separate southern Piedmont preserve. We have been in contact with numerous NCFS District and County offices around the state to begin further collaboration for the upcoming year.

Mountains: Under an ongoing partnership with UNC-Asheville, Dr. Jeff Wilcox continues to monitor the permanent wells established to monitor hydrologic conditions at Cedar Mountain Bog (Transylvania Co.) and Ochlawaha Bog (Henderson Co.). The data collected from these bogs not only helps to inform PCP Staff regarding the hydrology of these wetland systems, but also aids in the greater Southern Appalachian Bog management.

Piedmont: Eno River Association (ERA) (Durham Co.): The Association owns several small parcels important to PCP because of their location within a pollinator pathway connecting to PCP Preserves and other important conservation lands in northern Durham County. PCP has taken the lead restoring more open, savanna-like conditions on 3 tracts owned by the Association this year, totaling ~ six acres as part of a contract to help promote native pollinators and simultaneously promote rare plant populations. PCP staff created canopy light gaps and cleared brush to help prepare the ERA lands for newly planted native species. PCP volunteers facilitated seed collection and planting efforts to prepare seedlings for this project.

East: PCP gained additional funding from USFWS in 2016 to help monitor for laurel wilt, a devastating vascular disease impacting members of the laurel family including the common species such as redbay (*Persea borbonia*), swampbay (*Persea palustris*), and northern spicebush (*Lindera benzoin*) but also imperiled species such as pondberry (*Lindera melissifolia*) and pondspice (*Litsea aestivalis*). PCP Staff collaborated with the forest health branch of the NCFS to develop a monitoring protocol to survey for laurel wilt near the two preserves with these listed species: Pondberry Bay and Big Pond Bay. The funding will also allow for PCP to purchase a fungicide approved for (pre)treating impacted plants if this disease were to be located in close proximity to the preserves. Treatment of already impacted plants is rarely effective; however, the fungicide is only effective for approximately one year after treatment. Thus, PCP staff are working to monitor for increased threat of the disease before applying the treatment.

- ***Bat Fork Bog Preserve (Henderson Co.):***

Staff began collaborating with Bridget Lassiter, PhD Weed Specialist with the Plant Industry Division, to develop a treatment plan for optimal herbicide control methods for the highly invasive canary reed grass (*Phalaris arundinacea*). PCP plans to further collaborate with Dr. Lassiter to complete comprehensive site surveys to ascertain the presence and distribution of other exotic species of concern.

- ***Eno Diabase Sill Preserve (Durham Co.):***

PCP staff conducted a number of different activities on the Preserve during the year. Staff spent time thinning the midstory and burning the resulting brush to open the canopy and facilitate effective prescribed burns. Staff and volunteers performed extensive control activities to reduce invasive species such as Japanese stilt grass, sericea lespedeza (*Lespedeza cuneata*), and Queen Anne's lace (*Daucus carota*) as well as numerous other invasive plants. More than a mile of fire line was refreshed in preparation for burning the site. A prescribed burn was conducted on approximately 10 acres to improve habitat for imperiled species.

- ***Hebron Road (Durham Co.):***

PCP staff hand-thinned dense woody plant growth across approximately three acres of the Preserve to improve habitat conditions for imperiled plants. Related to the thinning activity, over 100 brush piles were established and burned. Control lines for upcoming prescribed burns were installed around a small portion of the Preserve and existing lines were refreshed. Considerable effort to control invasive exotic plants was conducted by staff, focusing primarily on Japanese stilt grass (*Microstegium vimineum*), hairy jointgrass (*Arthraxon hispidus*), and Chinese privet (*Ligustrum sinense*). A volunteer workday was held to help remove trash that had been dumped within the Preserve, mostly very old home site garbage which existed on the property prior to PCP ownership. The trash removed filled 50 large trash bags which were carried away by the City of Durham.

- ***Butner Cedar Glade (Granville Co.):***

PCP staff worked to control invasive species such as non-native wisteria (*Wisteria* spp.), nandina (*Nandina domestica*), Japanese stilt grass, and sericea lespedeza. Existing fire lines were refreshed.

- ***Pondberry Bay Preserve (Sampson Co.)***

Considerable progress was made in prescribed burning at this Preserve. In close collaboration, NCFS and PCP staff were able to successfully complete six controlled burns at this Preserve, totaling 390 acres. Additionally, in December, PCP staff collaborated with NCFS and a Clinton boy scout troop to plant ~300 longleaf pine seedlings on the preserve in an area which was recently cut over to remove planted loblolly pine.

- ***Eastwood Preserve (Moore Co.):***

Prescribed fires were conducted across 89 acres, nearly one third of the Preserve, by Muddy Oaks Management, LLC, under contract with PCP.

- ***Boiling Springs Lakes (Brunswick Co.)***

The use of mechanical mulching and midstory removal has continued in 2016 to restore former longleaf pine savannas and flatwoods which have become heavily overgrown with shrubs. Eighty-five acres were mulched along with 749 acres burned in collaboration with the NCFS. In many cases, the mulching machine is used to prepare burn units to allow for a safer controlled burn by removing ladder fuels and thus reducing the fire intensity.

In 2016, the PCP staff completed a multiyear collaborative research project with Dr. Jeff Glitzenstein, Research Associate and Beadle Fellow at Tall Timbers Research Station in Florida, to study the effects of mechanical restoration of pine savanna habitats at the two PCP Preserves. PCP staff received a final report from Dr. Glitzenstein which documents many new populations of rare and imperiled plants.

- ***Mineral Springs Barren (Union Co.):***

The first recorded prescribed burn was conducted on a 5-acre block of the Mineral Springs Barren Preserve by the NCFS with very good results. This unit has records of state listed plants which have not been observed in many years. PCP Staff intends to monitor in 2017 for rare plant reemergence and looks forward to expanding the collaborative burning options at this preserve with the NCFS.

- ***Redlair Preserve (Gaston Co.):***

PCP Staff worked to control invasive species such as wisteria, Chinese privet, autumn olive (*Elaeagnus umbellata*), Japanese stilt grass, and hairy jointgrass. Staff also used chainsaws to thin trees that were shading out rare plants in prairie-like openings. In the same vicinity, PCP staff, in collaboration with NCFS, conducted a prescribed burn for the benefit of federally listed Schweinitz's Sunflower (*Helianthus schweinitzii*). This burn was the first conducted at this preserve since PCP acquired the property.

Rare Species Monitoring

PCP completed intensive monitoring of five federally-listed plant species and several other rare species: smooth coneflower (*Echinacea laevigata*, Federally Endangered), Schweinitz's sunflower (Federally Endangered), bunched arrowhead (*Sagittaria fasciculata*, Federally Endangered), mountain sweet pitcher plant (*Sarracenia jonesii*, Federally Endangered, purple mountain pitcher plant (*Sarracenia purpurea* var. *montana*, Federal Candidate), bog rose (*Arethusa bulbosa*, NC Endangered), Venus flytrap (*Dionaea muscipula*, NC Special Concern-Vulnerable), swamp pink (*Helonias bullata*, Federally Threatened), and red Canada lily (*Lilium canadense* spp. *editorum*, NC Endangered). A census of seven smooth coneflower populations was conducted as part of an ongoing project to determine population trends for this species in North Carolina. Flowering trends for Schweinitz's sunflower, are relatively stable across PCP Preserves. Prescribed burning may have increased flowering numbers of this species at Mineral Spring Barrens, and possibly at Harvest Field preserve. A qualitative assessment of bunched arrowhead indicates a stable or increasing population at Bat Fork and Ochlawaha Bog Preserves. Flower production among mountain sweet pitcher plant and purple mountain pitcher plant populations was monitored at Cedar Mountain Bog Preserve. The recently reemerged endangered bog rose population has continued to increase in size with greater production in each year from 2014-2016. Venus flytrap individuals which were repatriated after

being confiscated by law enforcement from poachers were monitored to track our outplanting success at Boiling Spring Lakes Preserve. The swamp pink population adjacent to the Bat Fork Bog Preserve was monitored—this population grows on a parcel PCP is funded to purchase to provide better protection to this species as well as additional patches of bunched arrowhead. Lastly, the red Canada lily population also at Bat Fork Bog Preserve was monitored.

Several plant population discoveries and rediscoveries were made in 2016, in particular in the Durham and Granville County Preserves. A population of the NC Endangered veined skullcap (*Scutellaria nervosa*), was discovered at the Butner Cedar Glade Preserve (Granville Co.) as well as the rediscovery of the NC Endangered Piedmont quillwort (*Isoetes piedmontana*), previously last observed in the early 1990s. In addition, new patches of Special Concern-Vulnerable American barberry (*Berberis canadensis*), and NC Endangered shale-barren skullcap (*Scutellaria leonardii*) were found at the Eno River Diabase Preserve (Durham Co.). A population of NC Threatened pink thoroughwort (*Fleishmania incarnata*) was also discovered at the Eno River Diabase Preserve. Both the veined skullcap and pink thoroughwort discoveries were new species to the PCP Preserve system.

Steward Activity

Many of the management projects at the Durham Preserves (Hebron Road and Eno Diabase Sill) have been enhanced with the reliable help from two volunteer stewards who travel from Wake County to participate in a panoply of activities including, but not limited to, prescribed burn preparations, trash pick-up, invasive species control, seed plot establishment, seed collection, lead guided tours, etc. Herb and Pat Amyx are heading up augmentation efforts for smooth coneflower, state Endangered tall larkspur (*Delphinium exaltatum*), and state Threatened smooth aster (*Symphyotrichum leave var. concinnum*) at our Durham County preserves. For several years they have helped collect seed and propagate seedlings to return to the appropriate Preserves. These efforts have significantly increased the size of several of our smallest smooth coneflower subpopulations, and our only known population of smooth aster.

The Bat Fork Bog (Henderson Co.) volunteer steward, Tom Baugh, performed a variety of monitoring duties for bunched arrowhead and red Canada lily. He assisted in improving the understanding of the spatial extent and spread of imperiled and invasive species on the Preserve.

Stewards at Harvest Field (Randolph Co.), Mimi Westervelt & Kathy Schlosser, maintained augmented Schweinitz's sunflower individuals and participated in annual monitoring efforts.

Nancy Adamson, volunteer steward at Denson's Creek (Montgomery Co.) provided assistance in imperiled plant monitoring as well as began a site inventory to aid in our understanding of management needs.

The Mineral Spring Barrens (Union Co.) volunteer steward, Lisa Tompkins, recruited and organized volunteers for the annual plant monitoring effort, a much needed task given the greater distance from PCP's central location in Raleigh, Lisa's ability to recruit local volunteers is a great asset.

The Redlair Preserve (Gaston Co.) volunteer steward and prior landowner, Haywood Rankin, continues to contribute an extraordinary amount of time to the management of the preserve (on average 80+ hours per month). Haywood divides his time at the preserve between invasive plant control, monitoring for

invasive species, as well as boundary checks and addressing trespass issues. Haywood also leads tour groups and permitted researchers at this large preserve on behalf of the PCP Staff, increasing our capacity for engaging the public at this site.

The Cedar Mountain Bog (Transylvania Co.) has a new steward, Torry Nergart, Conservation Easement Manager with the Carolina Mountain Lands Conservancy (CMLC), a long-time partner of PCP in the southern mountain region. Torry is also helping to monitor the Ochlawaha Bog (Henderson Co.) and facilitate neighbor conversations. PCP hopes to deepen the collaboration between our office and CMLC for advertising volunteer stewardship activities.

The Tater Hill Preserve (Watauga Co.) has a new volunteer steward, Matt Estep, who is a professor at Appalachian State University researching evolution and population genetics of rare plants. He and a few of his graduate students are undertaking monitoring projects and facilitating property boundary marking at the preserve. Matt has also led guided tours both with and on behalf of PCP Staff.

Plant Pathology Program

Boxwood Blight

Boxwood blight has occurred in NC nurseries since October of 2011. Several nurseries experienced new infections of boxwood blight during 2016. Nurseries experiencing first time detections of boxwood blight in 2016 were located in Yancey and Alleghany counties. Nurseries with infected plants are currently located in Alleghany, Ashe, Surry, Wake, and Yancey counties.

Boxwood Blight Statement Program

In February 2012, NCDA&CS developed an optional “Boxwood Blight Statement Program.” Under the program, a NC nursery receives a statement to accompany shipments into other states. The participating nurseries are signees to a compliance agreement and follow best management practices. To facilitate this program, the NCSU Plant Disease and Insect Clinic assays samples collected during this process at no charge. As of December 2016, there are 75 participants in the program.

Greenery

In October 2016, NCDA&CS sent a letter to statement program participants concerning the risks posed by activities related to the use of boxwood as cut greenery. Boxwood greenery is a common component of holiday wreaths and garlands. The process of individuals going from field to field to cut this greenery is a pathway for the spread of boxwood blight. The letter urges growers to require sanitary precautions of all greenery cutters allowed in their fields. In addition, using infected greenery in holiday decorations provides a pathway by which the disease can spread into home landscapes. Despite this, infected greenery was found at several retail stores, resulting in 15 stop sales statewide. NCDA&CS worked with the producer and corporate offices of the retailers to ensure that infected products were removed from sales floors, once the disease was confirmed.

Farm Bill Funded Sanitizer Research

One of the best methods for mitigating losses due to boxwood blight is the use of good sanitation practices. Disinfectants are a critical component of sanitation. Sufficient contact times for commonly used disinfectants such as alcohol solutions and Lysol spray are difficult to achieve under field conditions due to the quick evaporation of these products. Therefore it is important to evaluate even more products, such as hand sanitizers with gels or foaming agents, to find an appropriate product that will provide longer contact time and thus be more effective at eliminating fungal spores. NCDA&CS received federal Farm Bill funding to evaluate sanitizers against the boxwood blight pathogen, *Calonectria pseudonaviculata*.

Because many NC growers specialize in large, field-grown plants, large equipment such as tree spades are needed for digging plants. In addition, the emergence of boxwood blight has effected the logistics of trucking and delivery. Many nurserymen now have truckers agree not to deliver commingled loads from multiple nurseries and to rinse containers and trucks between loads. Many products commonly used by the trucking industry have not been evaluated for efficacy against *C. pseudonaviculata*. More effective products with surfactants and foaming agents are needed to achieve sufficient coverage and contact time on large equipment, trucks, and containers. This project tests products or combinations of products that have not previously been evaluated, with the logistics of large, field-grown nursery production and shipping operations in mind. Experiments have begun and results are pending.

Sudden Oak Death (SOD)

Sudden Oak Death/ramorum twig and leaf blight caused by the plant pathogen *Phytophthora ramorum* is killing thousands of oak trees in California and Oregon. To prevent artificial movement out of the known infested areas, shipments of nursery host plants are regulated by federal and state quarantines. Field personnel have been involved with conducting nursery surveys and regulatory inspections for this disease since 2004. In 2016, NCDA&CS received federal Farm Bill funding to conduct surveys for *P. ramorum* and a related pathogen, *P. kernoviae*.

Surveys

Visual inspections were conducted at nurseries and big-box retailers in May and June. During September and October, big-box retail locations were inspected again. A total of 41 sites were surveyed. In addition, natural vegetation was inspected and sampled at nine locations. These natural vegetation survey locations were chosen based on likelihood of an epidemic spreading from a nursery into the natural environment. All natural vegetation survey sites were adjacent to nurseries, and contained high-risk genera such as *Rhododendron*, *Kalmia*, and *Quercus*. Three water samples were collected and analyzed from streams or standing water within nursery grounds, using the “bottle of bait” method.

Over 500,000 plants were surveyed as part of the SOD survey effort statewide. Special attention was given to *Rhododendron*, *Viburnum*, *Pieris*, *Kalmia* and *Camellia*. Symptomatic plants were sampled and submitted to the plant pathologist for testing for the presence of *Phytophthora* using enzyme-linked immunosorbent assay (ELISA). Thirty-nine samples were submitted of which two were *Phytophthora* positive. The *Phytophthora* positive samples were a *Rhododendron* sp. collected from a nursery and a *Pieris japonica* ‘Dorothy Wycoff’ collected from a big box retailer.

All samples that resulted in a positive ELISA test, were sent to Kansas State University-Manhattan Diagnostic Laboratory for further diagnostics. There were no positive identifications of the target pathogens in any of the samples screened during this survey.

Recurring positive location

Ornamental plants at a nursery dealer in Mecklenburg County have tested positive for the plant pathogen, *Phytophthora ramorum*, at various times since the first detection in 2008. Plant surveys were conducted both inside the nursery and in the surrounding natural areas during October of 2016 as part of the above-referenced, Farm Bill funded *Phytophthora* survey. All plant samples collected from the site during this survey tested negative for *P. ramorum* using molecular diagnostics. The NCFS also conducts water sampling in the stream directly outside of the nursery as part of a USFS regional stream-baiting project. Those results are pending.

Trace-forward/trace-back notifications

USDA-APHIS-PPQ notifies NCDA&CS when a nursery in another state has plants test positive for *Phytophthora ramorum* infection. If the positive nursery has recently sent host plants to NC, a trace-forward event occurs, the plants in question are inspected, and possible regulatory action is taken. No trace notifications occurred in 2016.

Miscellaneous SOD activities

The Plant Pathologist participates in monthly, national conference calls pertaining to the Sudden Oak Death program and provides summaries to the Plant Pest Administrator. Monthly conference call

participants routinely discuss issues such as: changes to national regulations, current trace-forward/trace-back investigations, updates from regulated states, on-going research, and workshop/training announcements.

The Sixth Sudden Oak Death Science Symposium was held in June in San Francisco, California and was attended by the Plant Pathologist and State Survey Coordinator.

Thousand Cankers Disease

Thousand Cankers Disease threatens eastern black walnut (*Juglans nigra*), a high value, ecologically, and culturally important tree species in North Carolina. The disease is caused by a fungus, *Geosmithia morbida*, spread by the walnut twig beetle (*Pityophthorus juglandis* Blackman (Coleoptera: Scolytidae)) and can kill trees in as few as three years once symptoms appear. Thousand cankers disease may also infect butternut trees (*Juglans cinerea*).

In 2016, NCDA&CS received federal Farm Bill funding to conduct surveys for the walnut twig beetle, and thousand cankers disease. Surveys spanned 27 counties throughout North Carolina. Traps were set along the NC/TN border and the urban areas of the Triangle, Triad and Charlotte-area, as well as northern and central coastal areas. Trapping efforts also focused around Haywood County in Western NC, the only location in the state where TCD is known to occur and quarantines are in place. A total of 88 Lindgren multi-funnel traps were set from May to early-June 2016. Samples were collected every two weeks for 10 weeks for 38 traps, and for 20 weeks for 50 traps (Table 18). **No walnut twig beetles were detected during these surveys.**

A special project was conducted in Haywood County to identify novel insect-pathogen relationships for *G. morbida*. To do this, a subset of bark beetles caught during the survey were sent to the USFS for molecular analysis. Preliminary results indicate that *G. morbida* was found in association with several bark beetles species, other than walnut twig beetle. This work is on-going and results are pending, but new regulatory actions are not anticipated since these beetles were trapped from Haywood Co., which is already under quarantine for this pathogen.

In addition to trapping, citizen scientists located declining walnut trees. Two citizen scientists provided 22 sites of declining walnut for further sampling and evaluation.

Table 18 Walnut Twig Beetle trap locations and sample collection dates.

County	Latitude	Longitude	2016 Trap Set	2016 Sample Collection Dates									
				1	2	3	4	5	6	7	8	9	10
Alexander	35.8958914	-81.21392006	5/18	6/1	6/30	7/11	7/21	8/9					
Alexander	35.92260605	-81.1789367	5/18	6/1	6/30	7/11	7/21	8/9					
Avery	35.96911352	-82.00690621	5/3	N/A	N/A	6/13	6/29	7/11	7/25	8/9	8/22	9/6	9/21
Avery	35.99011635	-81.94050018	5/4	5/16	6/1	6/13	6/29	7/11	7/25	8/9	8/22	9/6	9/21
Bertie	36.07826604	-77.1845613	6/1	6/15	7/1	7/20	8/2	8/12					
Bertie	35.90895267	-77.00818578	6/1	6/15	7/1	7/20	8/2	8/12					
Buncombe	35.50072117	-82.61089532	5/31	6/21	7/7	7/21	8/4	8/17	9/1	9/15	9/30		
Buncombe	35.53965869	-82.70739617	5/31	6/21	7/7	7/21	8/4	8/17	9/1	9/15	9/30		

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Burke	35.73251433	-81.68131243	5/18	6/7	6/30	7/8	7/21	8/10	9/1	9/15	9/30		
Burke	35.82757164	-81.73630677	5/26	6/7	6/30	7/8	7/21	8/10	9/1	9/15	9/30		
Cabarrus	35.22051535	-80.55719649	5/27	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Cabarrus	35.32109605	-80.52510999	5/27	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Caldwell	35.91937506	-81.49488794	5/26	6/9	6/30	7/12	7/21	8/10					
Caldwell	35.84871095	-81.63435113	5/26	6/9	6/30	7/13	7/21	8/10					
Carteret	34.79771885	-76.85161623	5/26	6/13	7/1	7/15	7/28	8/9					
Carteret	34.71034399	-76.62746513	5/26	6/13	7/1	7/15	7/28	8/9					
Catawba	35.6361121	-81.30958331	5/19	6/1	6/30	7/7	7/19	8/9					
Catawba	35.65323195	-81.23697816	5/19	6/1	6/30	7/7	7/19	8/9					
Cherokee	35.19768128	-83.79682346	5/26	6/20	7/6	7/20	8/3	8/16	9/1	9/15	9/30		
Cherokee	35.13475751	-83.98290403	5/26	6/20	7/6	7/20	8/3	8/16	9/1	9/15	9/30		
Clay	35.0273504	-83.73538687	5/26	6/20	7/6	7/20	8/3	8/16	9/1	9/15	9/30		
Clay	35.04673765	-83.8516792	5/26	6/20	7/6	7/20	8/3	8/16	9/1	9/15	9/30		
Craven	35.06219151	-77.07096636	5/25	6/10	7/5	7/15	7/29	8/10					
Craven	35.09177662	-77.0426274	5/25	6/10	7/5	7/15	7/29	8/10					
Durham	36.02252742	-78.89758803	5/25	6/10	6/23	7/6	7/19	8/5	8/22	8/30	9/15	9/29	
Durham	36.06754918	-78.90931713	5/25	6/10	6/23	7/6	7/19	8/5	8/22	8/30	9/15	9/29	
Forsyth	35.99567444	-80.39997946	5/11	5/25	6/7	6/22	7/8	7/21	8/4	8/22	9/2	9/16	
Forsyth	36.10834912	-80.28724242	5/11	5/25	6/7	6/22	7/8	7/21	8/4	8/22	9/2	9/16	
Gaston	35.39072907	-80.98019877	5/27	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Gaston	35.38813057	-81.04067251	5/27	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Gates	36.43138616	-76.69796736	6/1	6/15	7/1	7/20	8/2	8/12					
Gates	36.51290837	-76.8410092	6/1	6/15	7/1	7/20	8/2	8/12					
Graham	35.38004381	-83.66198982	5/25	6/15	7/5	7/19	8/3	8/16	9/1	9/15	9/30		
Graham	35.32391367	-83.80061921	5/25	6/15	7/5	7/19	8/3	8/16	9/1	9/15	9/30		
Granville	36.22084757	-78.62709544	5/25	6/10	6/23	7/6	7/19	8/5	8/22	8/30	9/15	9/29	
Granville	36.12110812	-78.69194412	5/25	6/10	6/23	7/6	7/19	8/5	8/22	8/30	9/15	9/29	
Guilford	36.12617015	-79.56015967	5/11	5/25	6/7	6/22	7/8	7/21	8/4	8/22	9/2	9/16	
Guilford	36.1754451	-79.67885041	5/11	5/25	6/7	6/22	7/8	7/21	8/4	8/22	9/2	9/16	
Henderson	35.37203821	-82.53383436	5/31	6/21	7/7	7/21	8/4	8/17	9/1	9/15	9/30		
Henderson	35.31749561	-82.45005016	5/31	6/21	7/7	7/21	8/4	8/17	9/1	9/15	9/30		
Hertford	36.44314407	-77.09757485	6/1	6/15	7/1	7/20	8/2	8/12					
Hertford	36.42186189	-77.08895115	6/1	6/15	7/1	7/20	8/2	8/12					
Iredell	35.79411141	-80.93784546	5/26	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Iredell	35.74950629	-80.89223234	5/26	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Jackson	35.36368963	-83.24649651	5/26	6/15	7/5	7/19	8/3	8/16	9/1	9/15	9/30		
Jackson	35.37874588	-83.26138414	5/26	6/15	7/5	7/19	8/3	8/16	9/1	9/15	9/30		
Jones	35.0628024	-77.35079768	5/25	6/10	7/5	7/15	7/29	8/10					
Jones	35.11469833	-77.32351188	5/25	6/10	7/5	7/15	7/29	8/10					
Lincoln	35.48124505	-81.04483136	5/26	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Lincoln	35.51701712	-81.04761444	5/26	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	

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Macon	35.22715404	-83.35281784	5/27	6/20	7/6	7/20	8/3	8/16	9/1	9/15	9/30		
Macon	35.13089757	-83.53613049	5/27	6/20	7/6	7/20	8/3	8/16	9/1	9/15	9/30		
Madison	35.92102959	-82.90215267	5/3	5/16	6/1	6/13	6/29	7/11	7/25	8/9	8/22	9/6	9/21
Madison	35.86246708	-82.90680289	5/3	5/16	6/1	6/13	6/29	7/11	7/25	8/9	8/22	9/6	9/21
McDowell	35.69145521	-82.06077812	5/18	6/3	6/30	7/8	7/21	8/10	9/1	9/15	9/30		
McDowell	35.63564302	-82.14326977	5/18	6/3	6/30	7/8	7/21	8/10	9/1	9/15	9/30		
Mecklenburg	35.50930804	-80.84507091	5/26	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Mecklenburg	35.4723855	-80.90038464	5/26	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Mitchell	36.07743403	-82.34501559	5/3	5/16	6/1	6/13	6/29	7/11	7/25	8/9	8/22	9/6	9/21
Mitchell	36.03533308	-82.22781527	5/3	5/16	6/1	6/13	6/29	7/11	7/25	8/9	8/22	9/6	9/21
Orange	36.07785215	-79.10037176	5/25	6/10	6/23	7/6	7/19	8/5	8/22	8/30	9/15	9/29	
Orange	36.04685299	-79.01133377	5/25	6/10	6/23	7/6	7/19	8/5	8/22	8/30	9/15	9/29	
Pasquotank	36.27929099	-76.3702656	5/31	6/15	7/1	7/20	8/2	8/12					
Pasquotank	36.27025975	-76.20571231	5/31	6/15	7/1	7/20	8/2	8/12					
Rowan	35.50811645	-80.55307231	5/27	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Rowan	35.60348176	-80.63449153	5/27	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Stokes	36.40654094	-80.37872464	6/2	6/15	7/5	7/29	8/19	N/A					
Stokes	36.42068705	-80.28727453	6/2	6/15	7/5	7/29	8/19	N/A					
Surry	36.49547322	-80.66310805	5/27	6/15	7/8	7/18	8/4	8/23					
Surry	36.5342204	-80.79955358	5/27	6/15	7/8	7/18	8/9	N/A					
Swain	35.43829353	-83.3973672	5/25	6/15	7/5	7/19	8/3	8/16	9/1	9/15	9/30		
Swain	35.39180059	-83.4742584	5/25	6/15	7/5	7/19	8/3	8/16	9/1	9/15	9/30		
Transylvania	35.13866973	-82.82095041	5/31	6/21	7/7	7/21	8/4	8/17	9/1	9/15	9/30		
Transylvania	35.31225647	-82.65137344	5/31	6/21	7/7	7/21	8/4	8/17	9/1	9/15	9/30		
Union	35.17089203	-80.57790785	5/27	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Union	35.12470798	-80.60295281	5/27	6/13	6/28	7/12	7/25	8/8	8/23	9/2	9/30	10/14	
Vance	36.44173957	-78.36847935	5/25	6/10	6/23	7/6	7/19	8/5	8/22	8/30	9/15	9/29	
Vance	36.32179144	-78.42376062	5/25	6/10	6/23	7/6	7/19	8/5	8/22	8/30	9/15	9/29	
Wake	35.78602889	-78.63710892	5/25	6/10	6/23	7/8	7/22	8/4	8/22	8/30	9/15	9/29	
Wake	35.79157668	-78.68658782	5/25	6/10	6/23	7/11	7/22	8/4	8/22	8/30	9/15	9/29	
Watauga	36.18414258	-81.60985362	5/24	6/6	6/30	7/13	7/25	8/8					
Watauga	36.21997598	-81.6394739	5/24	6/7	6/30	7/13	7/25	8/8					
Wilkes	36.09047484	-81.25323024	5/23	6/7	6/30	7/11	7/26	8/9					
Wilkes	36.03416387	-81.32167124	5/26	6/7	6/30	7/11	7/26	8/9					
Yadkin	36.23941558	-80.75789617	5/27	6/16	7/5	7/27	8/12	9/16					
Yadkin	36.25280329	-80.65127629	6/2	6/16	7/5	7/21	8/10	N/A					
Yancey	35.97746267	-82.44986405	5/3	5/16	6/1	6/13	6/29	7/11	7/25	8/9	8/22	9/6	9/21
Yancey	36.02014718	-82.34467825	5/3	5/16	6/1	6/13	6/29	7/11	7/25	8/9	8/22	9/6	9/21

White Pine Blister Rust

White Pine Blister Rust regulations prohibit the growing of *Ribes* species (currants and gooseberries) in NC because *Ribes* spp. are necessary alternate hosts to the white pine blister rust pathogen, *Cronartium ribicola*. The regulations were put in place to protect the white pine industry. Re-evaluation of this regulation has been put on hold. However, work towards this end has begun and will include consultation with representatives of the NC Forest Service, US Forest Service, and NC State University as well as other state departments of agriculture that have lifted similar *Ribes* bans in recent years.

Forest Pest Outreach

NCDA&CS staff delivered oral presentations to key stakeholder groups. Presentations generally covered the most imminent invasive pest threats to NC forests, namely, Asian longhorned beetle, emerald ash borer, redbay ambrosia beetle/laurel wilt disease, Asian gypsy moth, and walnut twig beetle/thousand cankers disease of black walnut. Information on basic identification techniques and pest biology was provided. In addition, participants were encouraged to report suspicious looking pests or damage to a phone number hotline or email address which NCDA&CS maintains for new pest reports from the public.

Notable presentations:

- Forest Health Symposium, NCSU McKimmon Center (invited)
- Cape Fear Botanical Gardens, talk and trapping demo (invited)
- Daily Planet Café lecture series
- NCDENR ‘Lunchtime Lecture Series’
- Central region forest pest workshop, Kerr Lake
- Eastern region forest pest workshop, Brunswick Co

In addition to oral presentations, outreach efforts took advantage of relevant public events. NCDA&CS set up booths at the NC Museum of Natural Science’s “BugFest,” which is attended by over 30,000 people and the NC State Fair, attended by nearly one million. Outreach efforts at the NC State Fair were paired with those of the NC Forest Service and focused on the “Don’t Move Firewood” message. It is estimated that approximately 500 individuals were reached directly through presentations and public events.

As part of Farm Bill funded outreach efforts, advertisements have been run in Western NC magazine and Triangle Gardener. Advertisements were graphics created by the USDA APHIS HungryPests campaign. More advertisements will be run during 2017.

Export: Disease certification requirements and pathogen distribution information

Most agricultural commodities exported to foreign countries and to some U.S. states must meet certain requirements with regard to plant pests. Countries and states differ as to what is perceived as a plant pest risk. The Plant Pathologist received and handled requests from Field Specialists for assistance with interpretation of plant disease and nematode certification requirements and determination of pathogen distribution.

Export: Tobacco blue mold – requirements for export of tobacco to China

If blue mold of tobacco occurs in a state's tobacco crop in a given year, that state must complete field surveys to detect the sexual spore stage (oospores) of the blue mold pathogen, *Peronospora tabacina*. If oospores are not detected in infected fields, the tobacco may still meet requirements for export to China. Survey procedures developed by USDA-APHIS-PPQ are required. The Plant Pathologist updates the NC survey procedures yearly and sends them to the NCSU Plant Pathology Tobacco Extension Specialist for distribution to NC Cooperative Extension Service county personnel in the event that blue mold occurs. NCCES county agents conduct the survey by collecting samples from affected counties and submitting them to an approved lab (i.e., the NCSU Plant Disease and Insect Clinic). Industry groups pay for sample assays. Blue mold occurred fields in Granville and Caswell counties in 2016.

Nematode certification

California has import requirements concerning reniform and burrowing nematodes. To assist nurseries that wish to send plants to California, Field Specialists collect soil samples and submit them to the NCDA&CS Nematode Assay lab according to procedures developed by the Plant Pathologist, who also provides oversight for this program. A sampling table based on numbers of plants or area sampled was developed by the Plant Pathologist. Using this table enables growers to pre-determine costs prior to sample collection and submission. [Note: Reniform and burrowing nematodes have not been found in any NC nursery. Reniform nematode was found in eight NC counties under agronomic field conditions, but burrowing nematode has never been found at any location.]

The Nematology Assay Section (NAS) Chief cooperates with the Plant Pathologist to test routine samples for soybean cyst nematode (SCN) in order to validate new-county detections. First-time detection of SCN was reported from Dare County during 2016.

Permits: Movement of plant pathogens for research and other purposes

The USDA-APHIS-PPQ Form 526 ("Application and Permit to Move Live Plant Pests or Noxious Weeds") permits the movement of plant pathogens and other pests into NC for research, diagnostic identifications, or commercial uses. The Plant Pathologist has the responsibility of adding comments to address state-specific concerns regarding each application. USDA-APHIS-PPQ issues final approval or denial of each application. All plant pathogenic organisms are subject to this requirement. The risk associated with each organism is evaluated to ensure that adequate safeguards are listed in the conditions of the permits. During 2016, 72 permit applications were evaluated. Pathogenic species evaluated included approximately 424 fungi/oomycetes, 69 bacteria, 30 nematodes, and 35 viruses.

Tobacco Plant Inspections

The NC Tobacco Plant Certification Regulation requires anyone who moves tobacco plants into NC from another state to do so under an import permit system. There were no import permit applications received during this reporting period. Another aspect of the regulation requires that plants grown in NC and sold for planting in a location more than seventy-five (75) miles away from the place of production must be inspected and certified. A major reason for this requirement is to prevent the artificial movement of blue-mold or virus-infected plants from one growing region into another, which could initiate a premature disease epidemic. There were no certified tobacco plant nurseries during this reporting period.

Vegetable Plant Inspections

The Vegetable Plant Certification regulation requires weekly inspections and certification of vegetable plants grown in NC for sale to commercial growers. There were no vegetable plant nurseries certified under this regulation during this reporting period. The NC Crop Improvement Association (NCCIA) certifies a large number of sweet potato cuttings and “seed” under its certification program. Because NCCIA certification requirements meet or exceed the standards of the vegetable plant regulation, NCDA&CS accepts inspections and certification tags of NCCIA in lieu of its own.

Other activities related to plant pathology

During this reporting period, the Plant Pathologist was involved with other plant disease issues. Examples include:

- Answered questions from the public as they relate to general plant problems;
- Continually reviewed scientific literature pertaining to new plant disease occurrences and research; expanded archive of important sources and articles for future reference
- Expanded database of *Phytophthora* species of potential concern with information such as: plant part(s) affected, symptoms, sampling methods, in order to stay abreast of future threats and ensure we sample and test for as many *Phytophthora* spp. as possible when conducting surveys
- Participated in windshield surveys for laurel wilt disease of redbay with NCFS personnel
- Attended relevant scientific meetings/seminars including the Southern Appalachian Forest Entomology and Pathology Seminar, the NCNLA’s Green n Growin’ show
- Participated in quarterly meetings of the North Carolina Pest Risk Committee
- Served on the National Clean Plant Network - Berries group, Tier II board. This group meets annually and discusses funding priorities, national clean plant standard harmonization, and outreach efforts concerning micropropagation technologies and the need for clean plant standards

Regulatory Weed Program

The North Carolina Regulatory Weed Program protects North Carolina agriculture, public health, and native plant ecosystems from the harmful impacts of noxious weeds. The regulation of noxious weeds is authorized by the North Carolina Plant Pest Law and the Aquatic Weed Control Act of 1991. Program activities include inspections, issuance of Phytosanitary Certificates, issuance of Scientific Permits for movement of regulated articles and the survey, control and eradication of listed noxious weeds. The Witchweed Eradication Project, funded by USDA-APHIS-PPQ, is also a vital part of the Regulatory Weed Program. In addition, the program manager recommends justified changes to the North Carolina Administrative Code that are relevant to noxious weed listings and quarantine boundaries.

Program Accomplishment Highlights

Witchweed Eradication

- The witchweed program continues to make gains in released acres in spite of the discovery of new or re-infested fields. The total acreage of active fields (i.e. fields with fewer than 5 points) is now 1,074 acres in NC.
- There were 105 acres of new or re-infested with witchweed in 2016. This highlights the need for vigilant survey, and shows the excellent work ethic of the Plant Pest Inspectors that are currently working on the witchweed eradication program. Three of these fields were discovered as part of planned Delimited Surveys in Pender county, as preparation for the eventual release of this county from the quarantine. Two of the three fields had been released from the witchweed eradication program in the mid 1990's, and one had been released in the mid 2,000's.
- 1,530 acres were treated in NC as part of the witchweed eradication program, using treatments of disking, ethylene, hand pulling, and herbicide use.
- A total of 68,055 acres were surveyed during 2016 to evaluate the status of witchweed infestation in the 5 quarantine counties of North Carolina.

Tropical Spiderwort

- An 8-acre, infestation of tropical spiderwort (*Commelina benghalensis*) was found at Claridge State Tree Nursery in Goldsboro in 2015. The site was fumigated in September of 2015, and released from quarantine in September of 2016. The site continues to be monitored.
- The Wake county location of Tropical Spiderwort was discovered in June 2015. It was hand rogued, treated with fire, and then sprayed with herbicides in 2015. Two additional herbicide applications were made to the site in July and September 2016. The population is diminishing, but will continue to be monitored in 2017.

Cogongrass

- Cogongrass (*Imperata cylindrica*) continues to be monitored in NC. There have been 3 actively managed sites since 2012, and no new plants were found in any of these sites in 2016. A large site found in Scotland County in December 2015 was used for a field-day and demonstration on June 2, 2016. Over 75 industry and agency attendees were able to see the plant *in situ*, and hear speakers discuss the life-cycle and treatment options. The site was treated with a 4% solution of Imazapyr (Arsenal) on June 10, 2016 by members of the USFS. The herbicide treatment was very successful, with yellow leaves noted 2.5 weeks after treatment. The site will be monitored for re-growth in 2017, and further herbicide sprays will be made as needed.

- Two additional sites of Cogongrass were discovered in Wake County in 2016 as a result of outreach efforts. One site, located at Wake Med Soccer Park in Cary, and the other at the McKimmon Center on NCSU's campus. Both sites were treated with herbicides during 2016, and will be monitored for re-sprouts of Cogongrass in 2017.

Other Noxious Weeds

- A small infestation of a Federal and State Noxious weed, Crested Floating Heart, (*Anoda cristata*) was discovered by Andrew Allen (NCDA&CS) in Guilford County in a small pond in May 2014. Herbicide applications were applied by staff from NCSU and NCDA during 2014, 2015 and 2016. The population has been reduced by 98%, and should be eradicated in 2018.
- Forty-six tropical soda apple plants (*Solanum viarum*) were found during the 2016 survey at Martin Meats and Faircloth Farms in Sampson County. The plants were bagged and incinerated.
- Small broomrape (*Orobancha minor*) continues to be confined to only a few plants in several locations of Mitchell County. Annual surveys are necessary to find the plants and destroy them to prevent additional spread. A small infestation was discovered on May 23, 2012 at the Western NC Regional Livestock Center near Canton, NC. Over 2500 plants were hand-rogued from the site in 2016, and herbicides were applied to the host to further reduce populations.
- Purple loosestrife (*Lythrum salicaria*) is still confined to two general sites; Forsyth County and Henderson County. Annual surveys are necessary to find the plants and treat them with herbicide to prevent spread. The Henderson county site continues to spread, so a more aggressive treatment plan will be conducted in 2017.
- Five sites are actively being managed for infestations of itchgrass (*Rottboellia cochinchinensis*) in Robeson County. A new site East of I-95 was discovered by Michelle Shooter (NCDA&CS) in 2014, and another new site was discovered in late 2015, and an additional two sites in 2016 surveys. Meetings with the landowners has hopefully started a partnership between NCDA&CS, NC DOT and the growers to help combat this weed. A preemergence herbicide of prodiamine was applied in early spring to help with new plants. Glyphosate was applied POST during the summer and fall of 2016 to control emerged plants and escaped plants were hand-pulled and disposed of.
- Efforts continued to evaluate efficacy of weevil releases as a biocontrol agent for mile-a-minute vine (*Persicaria perfoliata*) in Alleghany, Gates, Perquimans and Yancey counties.
- Giant hogweed (*Heracleum mantegazzianum*) has been confirmed at 6 separate sites in Watauga County. Herbicide treatment and hand-pulling were both utilized to control these infestations in 2016.

Regulatory

- 87 phytosanitary certificates were issued to support the witchweed quarantine program. This number has decreased in recent years because of the issuance of Compliance Agreements with several cooperators.

Public Relations and Outreach

The NCDA&CS Weed Specialist serves in an advisory role for a number of weed species in a number of workgroups. Tasks related to these responsibilities include attending numerous meetings across the state and weighing in or reporting upon the status of weed control programs. The groups are included in following list:

Committee or board member:

- NC Aquatic Weed Council
- Eno River Hydrilla Project (Outreach Committee, Scientific Committee)
- Hydrilla in the Chowan workgroup
- Lake Waccamaw Technical Advisory Group for Hydrilla management
- Aquatic Nuisance Species Workgroup
- Invasive Species Action Team – Albemarle Pamlico National Estuary Partnership

The Weed Specialist is a member of the following Regional Weed Science Groups:

- North Carolina Weed Science Society
- North Carolina Invasive Plant Council (Vice-President)
- South Carolina Aquatic Plant Management Society
- Weed Science Society of America

Educational talks were given to the following groups of people:

Date	Group	Location	Title of Talk	People Reached
March 16, 2016	NC Chapter of the Wildlife Society	Haw River State Park	Update on the Cogongrass Eradication Project in NC	75
May 14, 2016	Smith-Bryan Chapter of the DAR	Smithfield, NC	What does the NC Department of Agriculture do for You?	50
May 18, 2016	Weed Identification for Master Gardeners	Lee County Extension Center, Sanford NC	Weed Identification Tools and Tips	35
June 02, 2016	Cogongrass Field Day	Scotland County, NC	Cogongrass Identification and Status in NC	100
June 18, 2016	Forest Health Workshop - Eastern Region	Cunningham Research Station, Kinston, NC	Update on Cogongrass and other invasive Weeds in NC.	40

The Weed Specialist Participated in the following Research and Education Meetings:

Date	Group	Location	Title of Talk	People Reached
Tuesday, February 23, 2016	NC Aquatic Weed Control Council	Committee Member	<i>none</i>	--
March 09, 2016	North Carolina Weed Science Society	Raleigh, NC	<i>none</i>	--
March 10 & 11, 2016	North Carolina Invasive Plant Council	Catawba College, Salisbury NC	Witchweed - An update on the WW Eradication Program	65
Thursday, March 17, 2016	Bioenergy Research Initiative Update Meeting	Attendee	<i>none</i>	-
April 25, 2016	Cogongrass Education Meeting	Columbia, SC	Current Status of Cogongrass in NC	45
December 06, 2016	Crop Protection School	Raleigh, NC	<i>none</i>	--

Guest Lectures were given in the following classes in 2015:

Date	Group	Location	Title of Talk	People Reached	Contact Person for Group
February 4, 2016	CS 213 - Field Crop Production	NCSU - Raleigh, NC	Invasive Plants and Regulatory	40	Bob Patterson
February 12, 2016	CS 213 - Field Crop Production	NCSU - Raleigh, NC	Invasive Plants and Regulatory	20	Bob Patterson
February 22, 2016	CS 191 -Senior Seminar	NCSU - Raleigh, NC	Invasive Plants and Regulatory	40	Bob Patterson
March 03, 2106	CS 415 - IPM Course	NCSU - Raleigh, NC	Invasive Weed Program and Regulatory Issues in NC	45	David Jordan
March 30, 2016	CS	NCSU - Raleigh, NC	Invasive Plants and Regulatory	10	Bob Patterson

The Weed Specialist wrote or contributed to the following publications:

Date	Group	Activity	Title of Publication	Publication Type	Contact Person
Spring 2016	NC Vegetation Management	Author	Cogongrass found in Scotland County	Newsletter Article	Roxie Lee
April 05, 2016	NCDA&CS News	Contributed	NCDA&CS Hosts workshop in Scotland County on Identifying, eradication Cogongrass	Press Release	Andrea Ashby
July 01, 2016	NC Nursery and Landscape Association	Author	Be on the Lookout for Cogongrass	Newsletter Article	
July 01, 2016	Agricultural Review	Contributed	Workshop raises awareness of invasive weed	Newspaper Article	Andrea Ashby

Other Outreach Efforts:

- The Weed Specialist cooperated with Tom White of the NC Forest Service to organize a field day in Scotland County, NC for Cogongrass Education. Approximately 75 people attended from various State and County agencies, local farmers, and company representatives. Several guest speakers were able to discuss plant identification, invasive weed control options, and methods of dispersal for Cogongrass.
- The weed specialist and an employee of the Aquatic Weed Control Program sent letters to homeowners in the Upper Eno River Watershed to ask for permission to scout their farm ponds for the presence of hydrilla. Three days were spent scouting 30 different ponds to ascertain presence or absence of hydrilla. The results were published in color maps of the area.
- Numerous weed-related web pages were updated and placed on the Division Website. Fact sheets were created and printed for several invasive weeds so that they are available for various educational efforts.
- The Weed Specialist was asked to be the official verifier for invasive plant reports in North Carolina and posted to the EDDMaps website by the general public. There were over 500 entries that needed to be approved.
- The Weed Specialist was asked to assist Sam Brake in updating the Biofuels Best Management Practices Brochure. The original files were located, new graphics were created, and the brochures were printed by NCDA&CS, and were distributed at the 2016 biofuels field day in September.
- On several occasions assistance was provided to outside individuals who requested images of invasive weeds for publications and signage.
- On numerous occasions, assistance was provided to help identify weeds and provide weed control recommendations in crop, turf, aquatic and non-crop sites.
- On numerous occasions, assistance was provided to recommend control methods for a particular weed problem for a citizen or farmer who requests assistance.

Invasive Plant Risk Evaluations

In September of 2016, the NCDA&CS Weed Specialist collaborated with Tony Koop, of the USDA-APHIS PERAL Lab, located in Raleigh, to evaluate and publish a WRA (Weed Risk Assessment) for *Philydrum lanuginosum*. This plant, commonly called Woolly Frog's Mouth was found in Pender County, North Carolina in August 2016. This is the first find of this plant in the US. The WRA took approximately 60 hours of work to complete, and the Weed Specialist assisted in the final review of the WRA before publication. The final WRA was approved and published in September 27, 2016 at: https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/Philydrum-lanuginosum.pdf

Aquatic Dealer Inspections

Aquatic dealer inspections are completed each year by the Plant Protection Specialists. In 2016, the database organizing these inspections was revised. A new database will be rolled out to the Plant Pest Inspectors in 2017 to aid in better inspections of aquatic plants at nurseries and pet/fish stores.

General Weed Survey and Eradication Program Details

Survey Methodology and Rationale: Surveys for all projects were done by visual reconnaissance. Survey objectives are: 1) identify new infestations of target noxious weed (i.e. detection surveys); and, 2) delimit the boundaries where the weeds were mapped in previous years (i.e. delimiting surveys). Detection survey location targets were selected based on probability that subject plant pest would be present. In some instances GPS coordinates were recorded to provide reference points for mapping and relocation, if needed.

Roadsides close to wet areas and home landscapes were targets for Purple loosestrife detection surveys. Locations known to have been infested with small broomrape (*Orobanche minor*) in the past were checked several times during the summer for reoccurrence of the weed. Also, past known locations for itchgrass (*Rottboellia cochinchinensis*) were surveyed in June through October to monitor results of pre-emergent herbicide treatments applied in February 2016, and to ascertain new infestations. Cattle slaughter houses and holding farms in Sampson county are surveyed twice annually for infestations of tropical soda apple.

Since plant species must be identified during the growing season, all surveys are done during the period from full leaf (June) through the first hard freeze (usually mid-November).

Results of Active Weed Control Programs

Broomrape (*Orobanche minor*). *Orobanche minor* was discovered by Rebecca Norris and Kathy Kidd at the Western North Carolina Livestock Center near Canton, NC (Haywood County) in 2012. The infested area was burned with propane torches in 2012 to kill surface seed. The site was monitored during 2014 by Tim Hartley and James Corbin and treated as needed with a broadleaf herbicide to eliminate clover, which is a host plant of *Orobanche minor*. Approximately 15 plants were removed by hand in 2014, in a location measuring 5ft X 5ft. In 2015, Tim Hartley and James Corbin checked the site twice in May and found 120 new plants slightly uphill from the infestation in 2014. They were all removed by hand. In June 2015, about 325 plants were dug out by hand in an area of 5ft x 5ft. Repeated checks during the rest of 2015 revealed no new plants. In May of 2016 over 2,500 individual orobanche plants were dug out of the site, just slightly uphill from the original infestation. On May 16th or 2016,

the site was treated with herbicide to kill the host plant (clover). No additional plants were found during the rest of 2015. Close monitoring of the site will continue for at least a year before it is released.

A second site, a hay field in Mitchell County is also regularly checked. No new plants were discovered in 2015 or 2016.

Chinese Water Spinach (*Ipomoea aquatica*) Cooperation between the APHIS-PPQ inspector and the plant pest inspectors from NCDA&CS has continued in 2016. Compliance agreements were completed for 10 Asian markets who are known to be selling Chinese water lettuce in Durham, Guilford, Mecklenburg, New Hanover, and Wake counties. In late summer of 2015 it was decided to discontinue these agreements due to the risk associated with importing Sweet Potato Weevil (of which, *Ipomoea aquatica* is a host plant) if the plant was grown in a state other than NC. Therefore, there are only 3 remaining active compliance agreements between NCDA&CS, and those are for NC growers of *Ipomoea aquatica*.

Cogongrass (*Imperata cylindrica*). Cogongrass is considered a serious invader due to its ability to establish on a variety of soils and sites and ability to change ecosystem function by creating conditions for more frequent and hotter fires. It is a Federal and State of NC Noxious Weed that continues to invade thousands of acres across the Southeastern U.S. The first NC infestation was discovered in 2012 in Pender County. New infestations continue to be discovered, with 6 active sites now known in NC.

Late in December of 2015, a large stand of cogongrass was discovered in Scotland County, NC. The weed is in a pine plantation located on private property. A training session on identification and control methods for agency employees, farmers, and extension agents was held on



Figure 23 Cogongrass quarantine site in Scotland County after Imazapyr herbicide was sprayed. August 16, 2016.



Figure 24 Methyl Bromide fumigation at Wake Med Soccer Park. September 6, 2016.

June 2nd,

2016. Approximately 75 people attended the field day, which was held at the Cogongrass site in Scotland County. Steve Compton from Clemson University Plant Industry spoke on control methods and the status of Cogongrass in South Carolina. Tom White (NCFS) and Bridget Lassiter (NCDA&CS) spoke on Cogongrass identification and movement. The site was sprayed with a 4% solution of Imazapyr on June 10, 2016. The herbicide spray was quite successful, with a full burndown of the emerged plants occurring. Seeds from the plants were taken to the NCDA&CS seed lab, and tested for viability. None of the seeds were viable.

Two other new Cogongrass sites were discovered in Wake County in July of 2016. Both of these sites are believed to have been intentionally planted with the “Red Baron” type of ornamental Cogongrass around 2008, which has reverted to the green-biotype in the years since first planting.

The first site is located at the Wake Med Soccer Park located at 940 E Chatham St in Cary. NCDA&CS employees worked with the Town of Cary employees to complete several herbicide applications (July 29th 2016) and a methyl bromide fumigation of the site in September 2016. All of the rocks have been removed, the thatch from the Cogongrass destroyed, and new sod laid in the site. Monitoring of this site for Cogongrass escapes will be ongoing in 2017.



Figure 25 Wake County Cogongrass quarantine site after herbicide and Methyl Bromide treatment. August 30, 2016.

The second site is located at the NCSU McKimmon Center located at 1011 Gorman St, Raleigh NC. This location was a tip received from a member of the public. We worked with the NCSU groundskeepers to apply herbicide on July 25th and NCSU applied another spray of herbicide in August. The majority of the grass died as a result of these treatments, and the site was allowed to remain fallow for the remainder of 2016. The site will also continue to be monitored in 2017 for the appearance of any new grass sprouts.

Crested Floating Heart (*Nymphoides cristata*). Crested floating heart is established in south Florida, and was first discovered in Lake Marion, in the South Carolina Coastal Plain, in 2006. It has proven to be extremely difficult to manage in both states. The State Weed Specialist was successful in getting this plant, as well as two related species water snowflake (*N. indica*) and Yellow Floating Heart (*N. peltata*) placed on the NC state noxious weed list in 2012.

Crested floating heart was first discovered in North Carolina in May of 2014 in a private pond in Guilford County. Hydrothall 191 was applied by NCSU field staff in 2014, 2015 and 2016. The Weed Specialist visited the site on September 3rd, 2015 and in August 2016. The infestation has been reduced by 98%, and Andrew Allen will continue to monitor the site in 2017.



Figure 26 DEQ employees apply herbicide using an air boat to yellow floating heart in New Bern.

Yellow floating heart was discovered growing in a 3 acre pond located on a golf course in New Bern in the Fall of 2015. David Pearce and the Weed Specialist worked with the homeowners association to create an eradication plan for the pond in 2016. A presentation of the treatment plan was presented their plan to the Homeowners Association on April 12th, 2016, and herbicide treatments began in May 2016. A total of 4 herbicide sprays were applied to the entire lake during the year in cooperation with NCSU Crop Science department, and the DEQ Aquatic Weed Control Program. Herbicides that were used include

Aquathol K, and Imazapyr. The infestation was reduced by at least 50%, although the long-term impacts on the infestation are unknown. Herbicide treatments will continue in 2017 in cooperation with NCDA&CS and the DEQ Aquatic Weed Control Program.



Figure 27 Herbicide spray results on yellow floating heart in the Carolina Pines Golf Course Pond in New Bern, NC. August 18, 2016.

Giant Hogweed (*Heracleum mantegazzianum*). Giant Hogweed is a concern in NC because it is a dermal sensitizer – meaning that exposure to the sap causes a skin reaction known as photodermatitis that results in large painful blisters. The plants were first officially reported in the state in 2011.

There are now six sites (Table 19) in Watauga County where Giant Hogweed has been located, and is being managed by Chad Taylor. Each site is visited periodically, and treated when needed. The following list of sites (and accompanying GPS coordinates) describe the number of plants counted and treatment if it was needed for 2016. All plants are treated with a 3% solution of glyphosate.

Table 19 Known Giant Hogweed sites in Watauga County.

Site	GPS Coordinates	Location	Plants Found 2016
1	36.15037, -81.66012	Skiing Visitor Station	0
2	36.13680, -81.67685	Birch Drive House in Blowing Rock.	4
3	36.12144, -81.74338	Hillside. Planted for soil stabilization	60
4	36.11989, -81.74354	Housing Development	0
5	36.11446, -81.77836	Green Mt. Creek Waterfall	5

Giant Salvinia (*Salvinia molesta*)

Giant Salvinia, a Federal Noxious Weed, was detected at an aquatic nursery display at the North Carolina State Fair in 1998, and subsequent surveys by NCDA&CS, NCDENR, and NCSU personnel resulted in detections in 26 counties in North Carolina. All of these infestations have been eradicated, however, in September 2000, naturalized infestations of Giant Salvinia were detected in golf course ponds in New Hanover County and in a canal and wetland at the Riverbend near Burgaw in Pender County. Acting under the authority of the Aquatic Weed Control Act of 1991, NCDENR Water Resources personnel began herbicide treatments at these sites in November, 2000. A survey of the Northeast Cape Fear River and adjacent wetlands at the Pender County site in 2005 and 2007 yielded no new finds of Giant Salvinia. Survey and monitoring of the River Bend site in Pender County has continued to the present.

The current status of Giant Salvinia in NC is that there are no known populations. The Giant Salvinia Task Force is still consulted for technical advice on program activities, but the NC Department of Environmental Quality and the NCDA&CS work together to monitor the situation. Past locations were gathered from Mr. Wayne Batten in 2016, and a broad survey is planned for 2017 to determine eradication status.

Hydrilla (*Hydrilla verticillata*)

Lake Waccamaw: Hydrilla was found in Lake Waccamaw in 2012. An estimated 698 acres were infested. There are 28 rare species in the lake – including 11 mollusks, 4 fish and 13 other plants, making treatment efforts complex. Multiple state agencies banded together to put out herbicide treatments on the lake in 2014 at an estimated cost of \$486,000. Projected costs for treatment over the next 6-8 years is \$4.3M. Herbicide treatments were applied in 2014, and 2015. They have been very successful at controlling the existing vegetation and hopefully reducing the tuber bank in the soil.

Eno River: A technical committee was formed in 2013 to form a strategy for managing the Eno hydrilla infestation, and the State Weed Specialist is a member of that committee. It is estimated that \$50,000 will be needed each year for several years. Hydrilla is completely infesting all sections of the river in Eno River State Park. The second year of a two-year pilot study was completed in 2016, with 17 miles of the Eno River being treated with herbicide. The herbicide is applied using two separate drip type applicators installed on the river through a contract with SePRO Company. The treatments were highly successful in 2016, and did a good job controlling the hydrilla. The weed specialist was intensely involved with this project during 2016, driving to the sites every 7-10 days to refill the injectors with new herbicide, as well as to change out the batteries in the pump unit. The weed specialist also assisted in a large mapping project for the entire Eno River Watershed, and color maps were produced of the known sites containing hydrilla.

The pilot project was considered to be successful, and plans for 2017 involve treating a larger stretch of the river that will measure 21 miles in length. Seven funding partners have been identified by the Eno River Hydrilla Management Task Force, and each partner will contribute money to the effort. The contract will be approximately \$60,000 for the 3-month treatment period.

In addition to the main stem of the Eno River, farm ponds in the Upper Eno River watershed were surveyed for the presence or absence of hydrilla in an effort to understand the scope of the hydrilla problem, as well as the possible source of the infestation. Using aerial maps, ponds were identified and homeowners were

found and contacted about the project. Over the course of three days in August, September and October nearly 30 individual ponds were surveyed for the presence of hydrilla. Nearly 1/3 of the ponds (9 total) were positively confirmed for the presence of hydrilla. Treatment plans will be created and the landowners contacted to approach them about starting treatment of their ponds. An additional 30 farm ponds will be surveyed in 2017 using the same methodology.

Itchgrass (*Rottboellia cochinchinensis*). Itchgrass is a federal noxious weed, and poses problems because when touched because it can cause contact dermatitis to the skin. Efforts to control this weed in Robeson County have been ongoing since 1983. It was thought that the weed was eradicated in 1988, however it was detected again in the late 2000's. There are now 5 separate areas located around the town of Rowland, NC that are known to be infested with this weed (Table 20).

Table 20 Known Itchgrass sites located in Rowland, NC Robeson County. 2017.

Site #	Location Name	Year Discovered	Miles of Roadside to be Treated
1 (a)	Chicken Rd	2014	2.0
1 (b)	Dew Rd (End of Chicken Rd)	2015	0.6
2	Blue Pate Rd & US Hwy 301	1985, 2011	0.2
3 (a)	Williams Pond Rd	2014	4
3 (b)	Browns Farm Rd	2014	0.3
3 (c)	Cotton Valley Rd	2014	1.6
3 (d)	Echo Rd	2015	2.2
4	Hwy 501	2011	0.2
5	Iona Church Rd	Sept 2016	0.1

Five roadside itchgrass sites were treated with a PRE application of prodiamine herbicide on March 8th, 2016 by the NC DOT. Good control was achieved at all sites except for the Chicken Road site. The NC DOT also agreed to post "Do Not Mow or Spray" roadside signs at each of the 4 sites to encourage DOT contractors and farmers to avoid the areas. Seeds are likely moved around through equipment, and contract mowers are thought to have contaminated the Williams Pond Road Site in 2013.

Post emergence glyphosate applications were made by the NC DOT, Michelle Shooter (NCDA&CS) and local farmer, Kay McGirt, throughout the growing season when plants were located. Plants with seed heads were hand pulled and disposed of in plastic bags.



Figure 28 NCDOT employee spraying herbicide for Itchgrass control, March 2016.

In September 2016, roadside sites around the town of Rowland were scouted by Michelle, Bridget and several others. GPS coordinates were collected. Two additional infestations were discovered, and several other spots were also noted.

All of the known Itchgrass sites have been condensed into colorful maps using Arc GIS, and the maps have been posted to the Plant Industry website. Letters about the project were sent to landowners in the area so that they would understand the control measures that were being enacted in order to try and contain the weed. A public farmer meeting will be held in 2017, and Cooperation between DOT, NCDA&CS and Robeson Co. farmers is ongoing to detect and control infestations of itchgrass.



Figure 29. NCDOT signs posted at each itchgrass site, March 2015.

Mile-a-minute vine (*Persicaria perfoliata*)

Mile-a-minute (MAM) vine is documented in the following North Carolina counties: Alleghany, Gates, Guilford, Pasquotank, Perquimans, Rockingham, Watauga and Yancey counties. A population was found along the Mayo River in Mayo River State Park, downstream from a known infestation. During 2014 Park Superintendent Keith Martin recorded several more populations along the river.



Figure 30 Confirmed reports of Mile-A-Minute Vine in North Carolina, 2016.

Since 2011, biological control of MAM weed has been underway in NC under the supervision of Kathy Kidd (NCDA&CS). In May 2016, MAM weevils obtained from the New Jersey Department of Agriculture were released in Gates and Perquimans counties in an area where they were also released in 2014 and 2015. Existing populations of the weevils were noted, showing that the populations have become established in those areas. New weevil populations were released where there were no signs of feeding. In July the MAM sites were visited in Rockingham and Guilford Counties. On August 10th additional MAM weevils were released in Alleghany County. Extensive surveying of



Figure 31 NCDA&CS employees inspects MAM weevil feeding in Guilford County, June 2015.

existing sites was done, and several additional sites were located. The general consensus is that the weevils are going a good job of reducing leaf area on the MAM plant, but the MAM plant is also growing in more sites than ever.

Oriental bittersweet (*Celastrus orbiculatus*)

Farmers markets in Asheville, Greensboro and Raleigh were inspected for Oriental Bittersweet in 2016, but no sellers were found to be selling the plant.

A survey was conducted for the presence of Oriental Bittersweet in counties outside of the current quarantine counties (Figure 32). It is known that the plant is also found growing in Forsyth, Guilford, Surry and Yadkin county. The weed specialist was also notified of a population growing in Wake County in the town of Fuquay-Varina.



Figure 32 Quarantined counties where movement and sale of Oriental Bittersweet is allowed.

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a federal noxious weed. It is prevalent in riparian areas, and displaces native vegetation. It has an attractive purple flower, and was thought to have been intentionally planted in North Carolina. Eradication efforts have been ongoing for almost 20 years. There are two main areas that are in the process of being eradicated.

Site 1 – Guilford County:

Sixteen sites are located near Winston/Salem. The first three sites below are the most heavily infested, but eradication efforts have greatly reduced the number of plants present in 2016. Site 5 (Oak Grove Church Rd) is likely to be the original site, and there have been no plants there for 4 years. Site 16, a golf course, is managed by the golf course personnel and monitored by Andrew Allen. Plants were surveyed and treated on two dates in 2016 (May and July) (Table 21). The flower heads were clipped and placed in garbage bags for incineration, and the remaining plants were treated with a 1.5% solution of Element 3A (triclopyr). The sites will continue to be monitored in 2017, with herbicide treatments made as necessary.

Table 21 Purple loosestrife sites and acreages treated near Winston-Salem, NC.

				Treatment Dates	
Site	GPS	GPS Longitude	Acres	May 25, 2016	July 14, 2016
	Latitude			-----Plants Found -----	
I-40 West	36.07042893	-80.15678182	4.51	200	50
Rec Center	36.07213056	-80.15496865	2.03	5	0
Substation	36.07111048	-80.15596175	7.66	20	20
Farmingdale	36.08209177	-80.15750794	1.71	10	6
Oak Grove Church Rd	36.08275462	-80.1357344	0	0	
Megahertz	36.05817098	-80.17106929	1.97	6	4
Krispy Kreme	36.0562938	-80.17078946	0.79	0	
Corning Plant	36.05567246	-80.17498931	2.05	18	
Goose Pond	36.0535053	-80.18703683	7.83	15	5
Chaucer Lane	36.05043841	-80.18960097	3.82	8	0
Fox Meadow	36.0357447	-80.19275031	1.75	0	4
Villas	36.04122216	-80.20579241	0.57	0	
1-40 East Pasture	36.0686042	-80.1563407	1.46	10	2
Wallburg	35.9975458,	-80.0930742	2.23	0	0
Little White Church	36.04627997	-80.19543131	0.85	0	0
Willshire Golf Course	36.017487	-80.259329	3.32	0	0

Site 2 - Henderson County:

Purple loosestrife was also discovered in 2011 in Henderson County, and is being monitored by Sue Dial of NCDA&CS. Five separate sites are being treated (Table 22) around the Henderson County airport. The site was discovered by a stewardship biologist with the NC Wildlife Resources Commission. The second site (across the road from the airport) encompasses 20 acres; which includes two soybean fields, an alley between the fields, and the City of Hendersonville sewer line right-of-way.

Herbicide treatments at the sites are ongoing. A complete survey was planned for October 2016, but a gas shortage in the state halted those plans. A complete survey of the site will be conducted in the summer of 2017 in order to make a more aggressive treatment plan.

Table 22 Purple loosestrife sites and acreages treated in Henderson County, NC.

		Treatment Dates	
Site	Acres	June 2016	September 2016
--- Status Report ---			
Airport (ditches)	1	Fewer plants	
Large Soybean Field	8-10	Large plants along both edges	
Small soybean field	2-3	Fewer plants along long edges, but majority located along north edge. Many large plants in woods.	
Home on Beverly Rd	>1	One plant located just inside chain link fence	
Sewer Alley	>1	Fewer plants than before, no large plants, just small new plants along the path.	
Roadside	>1	Many large plants. DOT mower there mowing plants. Plants contained in the area between the bridge and curve at the garage on both sides of the road.	

Tropical Soda Apple (*Solanum viarum*)

Tropical Soda Apple is a concern because the plants are large and spiny. Cattle prefer to eat the fruits, and thus the seeds are spread wherever cattle are moved in from areas where this weed is common (i.e. Florida). It has been managed for several years at two sites in North Carolina, under the supervision of Herbie Ward.

Spot surveys were completed by Herbie in July of 2016. A thorough survey was completed using ATV's on October 13th 2016 at both Faircloth Farm and Martin Meats (Table 23). No plants were found at Martin Meats. The plants found at the Faircloth Farm ranged from small (6 inches) to large (24 inches). Some large plants did have unripe fruit on them. All plants were pulled and disposed of in paper yard waste bags and incinerated.

Survey efforts at both of these sites will continue in 2017.

Table 23 Tropical Soda Apple survey sites, Sampson County.

Date	Location	Acres	Fields	Plants Found	Survey Crew
July 2016	Martin Meats	10	1	0	Herbie
July 2016	Faircloth Farm	30	1	0	Herbie (Spot Check)
October 13 2016	Martin Meats	260	26	0	Cleveland, Earl, Herbie, James, Richard, Bridget
October 13 2016	Faircloth Farm	850	8	46	Cleveland, Earl, Herbie, James, Richard, Bridget
Totals		1150	36	46 Plants	

Tropical Spiderwort (*Commelina benghalensis*)

Tropical Spiderwort is a federal noxious weed, and has several methods of reproduction, including underground flowers and tubers. Propagation of this plant can occur from stem cuttings, seed or tubers. Several locations of the plant have been found in NC since 2001, but the quarantine area is currently confined to two locations in Wayne County, NC (one additional added in 2015). The quarantine for Tropical Spiderwort remains active at the Cherry Research Farm near Goldsboro (Site 1). An additional quarantine was established at Claridge State Nursery in Goldsboro NC in August 2015 (Site 2). A third site (Site 3) was discovered in Raleigh and is under treatment for eradication.

Site 1: Cherry Research Farm

Tropical Spiderwort was found in a new field (Field 13) in September 2014, not located within the Farming Systems Unit. That field was fumigated in November 2015, and was monitored by Ann Gallagher until November 2016, when it was released to be planted to crops again on November 23rd.

Richard Banner of NCSU continues to monitor the infested crops located inside of the CEFS research station. As of September 2016, he had found and destroyed 255 plants out of plot 12, one plant in plot 23, and two plants in plot 26. Hurricane Mathew came into the region in October of 2016, and flooded that farm. It is likely that TSW propagules have moved, and this area will need to be closely monitored in 2017 for new plants.

When equipment is sold, or moved off of Cherry Farms, it needs to be fumigated and inspected prior to transport to ensure that no propagules of TSW remain on the equipment. The following fumigations (Table 24) and inspections were performed by Ann Gallagher.

Table 24 Equipment Fumigations and Inspections at Cherry Farms, 2016

Fumigations:	Inspections:
3/18 - KMC strip tiller, JD 1700 6-row planter	4/01 - Silage bagger
4/29 - Case 6/11 planter	6/06 - 2-row planter, KMC planter
5/10 - 4-row air planter	6/14 - Test plot combine
6/06 - 2-row RJ Brand carousel, 2-row mechanical planter	6/28 - Cone planter
6/14 - 4-row cultivator	7/07 - Plastic layer
9/14 - Tractor	8/31 - Silage bagger
	10/31- Plot planter
	11/04- Planter, 4600 ID plot planter

Site 2: Claridge Nursery

During August 2015, Tropical Spiderwort was found in a field of Loblolly Pines at Claridge State Nursery (also located in Wayne County approximately 5 miles from the CEFS Farming Systems Unit). A significant portion of the 8-acre field was found to be infested with TSW. The rest of the nursery was surveyed for the presence of TSW, and found to be clean. The positive field was sprayed with Gramoxone, and burned with fire, and then bushhogged and disked to eliminate biomass. Weather conditions did not permit fumigation of the field with Methyl Bromide in the Fall of 2015, but the 8.2 acre field was successfully fumigated by TriEst Ag on April 19, 2016. The plastic remained on the fumigated field until June 7th. Rain from Hurricane Mathew resulted in the field being completely submerged. The field was re-surveyed by Ann Gallagher on November 23rd 2016, and was found to be clean of Tropical Spiderwort.

Site 3: Wake County Site

On Friday September 11th, an NCSU student alerted NCDA&CS to the presence of TSW in a private apartment complex in Raleigh, NC. A sample was collected and confirmed by Alexander Krings (NCSU Herbarium). On September 16th, 5 NCDA&CS employees visited the site and hand rogued out the small patch (measuring ~15 ft x 15ft) of plants. On October 16th of 2015 a herbicide application of Dual Magnum and Roundup was applied to the site. The first seedlings emerged around June 2nd, of 2016. An herbicide spray was applied on July 11th, 2016 as well as in October of 2016. The site will continue to be monitored for several years to ensure eradication. An adjoining storm drain was also identified, and using a map of the storm drains provided by the City of Raleigh, surveys were completed by April Bauder, Justin Karl and Bridget Lassiter to ensure that the plant had not traveled downstream in the storm drain.

Cherry Research Farm Visitor Logs: All visitors to the Cherry Research Station are asked to sign in at the Tropical Spiderwort Quarantine area, and keep a log of visits to the wash station. Ann Gallagher, NCDA&CS Eastern Region Supervisor reported the data shown in Table 25 for the quarantine log.

Table 25 Tropical Spiderwort quarantine visitor sign-ins and wash station log, 2016.

Month	Visitor Sign-Ins	Wash Stations Log
January	55	6
February	9	13
March	58	40
April	33	72
May	62	92
June	223	39
July	743	78
August	81	70
September	29	44
October	98	30
November	35	28
December	20	3
Total Sign-Ins	1,446	515

Woolly Frog's Mouth (*Philydrum lanuginosum*)

A plant identified as Woolly Frogs Mouth was identified on August 8, 2016. This plant was found to be growing in a private residence around a “Borrow Pit” located near the Holly Shelter by a member of the Wildlife Resources Commission. They were surveying the pond for the presence of the rare Gopher Frog, and noticed that the plant was taking over the pond in a very short amount of time. A group of government representatives visited the site on August 22nd, 2016. Using information gathered at that time, a weed Risk Assessment was completed by Tony Koop (USDA-APHIS). It was determined that this was the first U.S. finding of this plant in a naturalized location, and that herbicide treatment was needed. A 5% solution of Rodeo (Aquatic glyphosate) was applied to the pond's perimeter on October 4th, 2016. Good control was achieved, as observed by Plant Pest Specialist Scott Cannady. Further treatment and survey is planned for 2017 to ensure that this plant has not spread from the immediate location. The Holly Shelter Gamelands was surveyed by vehicle by the Weed Specialist on October 4th, 2016, and a Pest Alert was produced and posted to the NCDA&CS website. This plant was reported to the NAPIS website on 09/21/2016 as “Woolly Waterlily”.



Figure 33 Glyphosate applied to a population of Woolly Frog's Mouth in Pender County.

Witchweed (*Striga asiatica*)

Witchweed (*Striga asiatica*) is a Federal Noxious Weed and a Class A State Noxious Weed in North Carolina. It is an obligate parasite, and needs a grassy host such as corn, sorghum, millet, rice and several other warm season grasses. Heavy infestations of witchweed can eliminate yield from these crops, resulting in devastating economic losses. The presence of this quarantined pest also imposes a regulatory burden on crop production and on the movement of farm commodities, equipment, and other regulated articles. The witchweed eradication program includes an organized and effective set of survey, control and regulatory procedures developed through early USDA, APHIS research.

Specific objectives of the program include: 1) characterization of the infestation through survey; 2) control of existing infestations; and, 3) containment by preventing the movement of potentially infested articles out of established quarantine boundaries.

Survey – Survey is necessary to detect and verify the extent of witchweed (Detection and Delimiting surveys), evaluate the effectiveness of eradication treatments on infested properties (Appraisal surveys), and verify eradication of witchweed on sites released from quarantine (Released surveys). Additional survey of terminated acreage is required in order to confirm the long-term effectiveness of the eradication program. Survey is done through the growing season after host plants have started to grow from about the middle of June through the end of October or until the first frost.

Control – The objective of control treatments is to prevent witchweed seed production and eliminate witchweed seed from the soil. Herbicide treatments, hand pulling and disking help to control witchweed host plants and witchweed plants before they can flower and produce seed. Ethylene applications also help to deplete soil reserves of witchweed seed by encouraging germination and subsequent control by exposure to treatments or a non-host crop. Control treatments can be completed during the growing season and into the winter months provided soil moisture and temperature are favorable for soil fumigation.



Figure 34 Applying ethylene to a field formerly flooded for duck hunting.

Regulatory – Regulatory activities aid in preventing the artificial spread of witchweed from infested areas to non-infested sites. These regulatory functions facilitate the interstate and intrastate movement of agricultural commodities from witchweed regulated areas

Witchweed Eradication Program Data Compilation Description

A point system was developed for the program that provides a quantitative measure for moving fields from infested to a released status and from a released status to a terminated status. All control treatments and surveys are tracked in an *Access* database that automatically updates the point values for released fields and tracks assigned point values for infested fields. New or re-infested fields are added to the infested field list when witchweed is confirmed in new fields or in fields that have been previously released. The points assigned to infested fields are determined by the nature of the field and the control activities that were completed during the season. Once a field accrues five points it is advanced to “Release” status which means it is surveyed for a minimum of 10 years on a predetermined schedule that includes some skip years and either a spot survey or survey of the whole field (general survey) in the other years. A spot survey qualifies the field for 0.5 points and a general survey qualifies the field for 1.0 points. Once a field acquires a total of 10 points, of which 5 are assigned during the 10-year release survey period, it is terminated from the program.

The following summary tables show the status of acreage in North Carolina as of the end of survey and treatment for the current growing season which usually occurs by mid-November each year. Since point values for a field are adjusted only once at the end of the growing season, it is not possible to obtain an accurate end of season account of field status until survey and treatment have ended for the year.

The following is a description of steps used to compile year-end summaries from the *Access* data base:

- Based on input from each inspector, infested field point values are manually adjusted to reflect current field conditions and treatments that were done during the year. In most instances, fields will be advanced in point value. Some fields may qualify for release based on reaching a point value of 5. Infested field point value at the end of the season is a judgment based on knowledge of witchweed biology, field treatments and current field conditions. The new field point values are assigned at the end of the growing season after the first frost when it is assumed no more treatments for the year will be implemented and no new witchweed will be found.

- New fields are added to the data base and are assigned a new farm and/or field number. Re-infested field point values are changed to bring them back to values less than 5 so that they will be tallied as infested fields.
- After end of growing season adjustments, the data base is queried and standard reports are generated to provide updated statistics for acreages infested, released, surveyed and treated.

2016 Witchweed Program Discussion

We had an average spring and early summer field season this year, with temperatures staying cool until mid-season, where the year turned out to be very warm. The fall was dry until October, when Hurricane Mathew hit the majority of the Eastern half of North Carolina. Many of the Witchweed fields were submerged in water, roads were closed, and employees were without power in their personal homes. For the most part, Witchweed survey activities were suspended for one week until conditions improved. Of course, the hurricane likely moved soil and plants around in the infested counties, and survey activities in 2017 will reflect that. A killing frost occurred during the first week of November, and the last field surveys for Witchweed were completed during the second week of November, so we feel fairly certain that we controlled any flowering witchweed in our active fields. During the field season (May through October), active fields were visited and treated every 14 days, thereby eliminating much of the risk that Witchweed would flower and produce more seed.

A newly infested Witchweed field was discovered in South Carolina, just three miles from the North Carolina border. To the best of our knowledge, this field had never been infested in past years. The farmer tending that land lives and also works in North Carolina. An inventory of his fields was created, and all of those 100 fields were surveyed by North Carolina Plant Pest Inspectors, and no new infestations were found in North Carolina.

Several fields (equaling 143 acres), previously released or terminated fields were discovered to be re-



Figure 35 NCDA&CS Witchweed staff, Bladen County, September 2015.

(L to R) Bridget Lassiter, Carlie Averitt, James Bullard, Richard Smith, Cleveland Chavis, Earl Brewington and Justin Karl.

infested with Witchweed. There are several ways that the fields could have been re-infested (contamination from equipment on the farm, movement of contaminated articles, or a long-lived seed bank), and we attribute the very astute actions of the plant pest inspectors in finding the fields. In many cases, the inspectors stop to look at fields that have been released from the program (therefore not requiring a formal inspection) when they happen to be in the area inspecting other active fields. This situation emphasizes that this eradication program takes many years to be successful due to the very long seed viability (>15 years), and that prematurely ending the program could result in many new re-infested fields.

2016 Witchweed Eradication Program Summary of Results

Table 26 summarizes acreage status for fields managed in the Witchweed Eradication Program in North Carolina. The number of infested acres dropped in 2016, as compared to 2015 due to termination. However, a total of 143 new or re-infested acres were added to the infested category. These new or re-infested acres include three different fields located in Pender county that our inspectors have been checking in preparation for releasing of the entire county from the program. Two of those fields had been terminated in the 1990's, and one had been terminated in 2004.

Over 1,400 acres were terminated from the program in 2016, but the resulting 3,876 acres are still subject to point system rules that include mandatory scheduled surveys.

Table 26 Total Acreage Status for the Witchweed Eradication Program

	2015	2016
Total Acres in Infested Category	1,141	1,074
Total Acres in Released Category	4,053	2,803
Total Acres Managed by Program	5,194	3,877
Total Acres Treated	1,873	1,484
Total Acres Surveyed	57,208	68,055
Acres Transferred from Infested to Release Category	167	105
Acres New or Re-Infested	<u>- 575</u>	<u>- 143</u>
Net Gain in Eradicated Acres	-408	-38

Other pertinent program data is summarized in Table 27. Twelve witchweed bounty payments were requested by temporary inspectors in 2016. Phytosanitary certificates are issued for movement of regulated articles moving out of the quarantine areas such as straw mulch used by the NC Department of Transportation. Eighty-seven certificates were issued during 2016 compared to 49 issued in 2015. Witchweed was detected on 53 fields in 2016.

Table 27 Additional Statistics for the Witchweed Eradication Program

	2015	2016
Acres Treated by Contract	0	10
Counties now Infested in NC	5	5
Number of Witchweed Bounty Payments	4	12
Associated Witchweed Bounty Acreage	27	153
Number of Witchweed Infested Fields with Positive Sightings	82	53
Total Number of Witchweed Observations	204	303
Number of Phytosanitary Certificates Issued	49	87

The point status of infested fields provides an indication of how many years the field might remain in the program before being moved into the released category. Acreage currently with 4.0 or 4.5 points would have a high probability of being released within the next 2 years. Table 28 shows infested field acreage by point value and County for 2015 and 2016.

Table 28 Infested Acreage by Point Value and County for 2015 and 2016.

County		0-0.9 Acres	1-1.9 Acres	2-2.9 Acres	3-3.9 Acres	4-4.9 Acres	Infested Acres
Bladen	2015	105	129	196	53	49	531
	2016	199	27	67	129	118	540
Cumberland	2015	81	3	0	25	169	278
	2016	92	1	26	6	49	174
Pender	2015	0	0	6	3	0	9
	2016	13	0	0	6	0	19
Robeson	2015	135	2	13	97	60	307
	2016	135	0	14	92	84	325
Sampson	2015	0	0	12	12	4	16
	2016	0	0	0	12	0	12
Total	2015	321	134	228	190	282	1141
	2016	439	27	108	244	251	1069

In addition to infested acreage, another measure of the size of the Witchweed program is the number of infested farms and fields that are currently being managed with scheduled surveys and treatments. Table 29 shows the number of infested farms and fields by county for 2015 and 2016. There are currently 67 farms and 100 fields classified as infested (i.e. fields with fewer than 5.0 points) in the program. Including released fields for which surveys are still scheduled, there are a total of 376 fields still managed by the program.

Table 29 Number of Infested Farms and Fields by County for 2015 and 2016.

County		No. of Farms	No. of Fields	Infested Acres
Bladen	2015	34	55	531
	2016	34	57	540
Cumberland	2015	32	41	278
	2016	16	20	174
Pender	2015	1	2	9
	2016	2	2	19
Robeson	2015	12	17	307
	2016	13	19	325
Sampson	2015	3	3	16
	2016	2	2	12
Total	2015	82	118	1,141
	2016	67	100	1,069

Table 30 summarizes treatment acreage by crop type. Treated acreage is recorded for each treatment event and fields may get treated more than once during the season, so the totals are cumulative. The type of crop planted into infested fields is an important indication of whether or not Witchweed is likely to emerge and be detected during the growing season.

While corn was the primary host crop (present on 80% of the 1,141 infested acres treated in 2015) most of the 2016 acreage is classified as “Other”. This represents one very large farm in Sampson county that allowed our inspectors access to “Food Plot” acres that had been infested for many years. Food plots are normally planted to a legume or seed crop, allowed to mature, and then flooded during the fall and winter months to allow for hunting of game and waterfowl. The land-owner allowed for the land to be drained, and we applied ethylene to all fields two times. Ethylene application is expected to reduce the eradication time by 1 to 3 years at this farm.

This table also indicates that a large portion of the treated acreage is idle land (usually pastures or abandoned garden plots). Idle land can easily be treated with herbicides, ethylene and disking, but garden spots are harder to manage because of proximity to residences and power poles.

Table 30 Summary of Treated Acreage by Crop Type for 2015 and 2016

Crop Name		No. of Acres Treated
Corn	2015	910
	2016	266
Soybean	2015	97
	2016	125
Idle	2015	558
	2016	349
Other	2015	307
	2016	744
Total Crop Acres Treated		
		2015
		2016
		1,873
		1,484

Table 31 describes Witchweed treatments that are applied to prevent witchweed from flowering and producing new seed, as well as those used to deplete reserves of seed still present in the soil. Ethylene applications are our main early-season control method. They help to hasten depletion of seed reserves by artificially stimulating Witchweed germination. In the absence of host plants, germinating Witchweed is unable to complete its life cycle and produce new seed (referred to as suicide germination). Disking (also completed in early-season) helps to remove grassy weed hosts and therefore also deny opportunities for additional Witchweed seed production. Hand pulling of emerged Witchweed plants before seed sets will also eliminate additional seed production, and is the main control method used in mid-late season.

Herbicides are used to directly kill emerged Witchweed plants and to kill weedy hosts in false host crops (cotton) and host crops (corn or sorghum). Herbicides are also used to kill weeds on the fringes of fields to provide better conditions for Witchweed detection.

- The use of fumigants is rarely used in the program now due to new buffer zone requirements, NCDA agency guidelines, and the high expense. Soil heat treatment, has been used in the past, but has not been utilized recently.
- Roundup Powermax® is the most commonly used herbicide due to the large percentage of soybeans and corn that are planted to Roundup-ready crops.

Table 31 Summary of Acres by Treatment Type for 2015 and 2016.

Treatment Type		No. of Acres Treated	No. of Treatments
Disking <i>Treatment Code 39</i>	2015	722	84
	2016	746	138
Ethylene (Tractor and Hand) <i>Treatment Code 43</i>	2015	306	37
	2016	302	57
Hand Pulled <i>Treatment Code 61</i>	2015	541	201
	2016	105	205
Herbicide to Host <i>Treatment Code 94</i>	2015	349	27
	2016	339	31
Herbicide to Witchweed <i>Treatment Code 95</i>	2015	13	7
	2016	11	7
Herbicide (Survey Aid) <i>Treatment Code 96</i>	2015	0	0
	2016	28	7
Total Acres Treated		2015	356
		2016	445

The success of the Witchweed eradication program is largely dependent on the quality and quantity of field inspections completed during the growing season. Over 68,000 acres were surveyed during 2016 Table 32. This number is an increase from 2015. Part of the increase is because our whole complement of survey staff was employed for the entire season (a Plant Pest Aid position was vacant during the majority of the 2015 season).

In addition, we began conducting delimiting surveys in fields that had been released from the Witchweed Eradication Program in Pender County. Some of these fields were released prior to 1995, when the USDA still held the program. It was expected that these fields would be clean of Witchweed, but in fact three positive finds were made out of the nearly 100 inspected fields. As surprising as this is, it is further justification for the importance of this program. These three fields have been brought back into the Witchweed Eradication Program (moved from Terminated to Active), and will continue to be monitored. The remainder of the released fields in Pender County will be surveyed in 2017.

Surveys determine the effectiveness of treatments on active fields (Appraisal Survey) and provide assurances that fields remain Witchweed-free between the time they are released until they are terminated from the program (Release Survey). Delimiting surveys are also completed on fields adjacent to infested or released properties to assure infestations remain contained. Detection surveys are also completed on fields which may be outside of the Witchweed quarantine area to ensure it has not spread outside of the designated quarantine area.

Table 32 Summary of Surveyed Acreage for 2015 and 2016.

Category		Total Acres
Appraisal	2015	8,399
	2016	11,381
Release	2015	13,600
	2016	12,730
Delimiting	2015	30,691
	2016	39,701
Detection	2015	4,438
	2016	4,210
Regulatory	2015	80
	2016	33
Total Acres Surveyed		
2015		57,208
2016		68,055

2016 Program Overview**Table 33** Number of Farms and Fields by Point for each Officer.

Infested										
Points	<i>Brewington</i>		<i>Chavis</i>		<i>Smith</i>		<i>Bullard</i>		Total	
	Fields	Acres	Fields	Acres	Fields	Acres	Fields	Acres	Fields	Acres
0 - 0.9	23	210	2	135	9	99	0	0	34	444
1.0 - 1.9	3	17	0	0	1	11	0	0	4	27
2.0 - 2.9	4	48	1	14	4	46	0	0	9	108
3.0 - 3.9	3	15	9	92	11	135	3	4	26	244
4.0 - 4.9	2	10	7	84	12	118	6	39	27	251
Sub Total	35	299	19	325	37	408	9	43	100	1074
Released										
5.0 - 5.9	8	24	3	51	7	87	12	110	30	271
6.0 - 6.9	8	94	3	21	8	73	7	66	26	254
7.0 - 7.9	10	90	10	134	7	94	12	320	39	637
8.0 - 8.9	26	208	17	174	17	204	13	161	73	748
9.0 - 9.9	21	218	18	205	23	132	46	337	108	893
Sub Total	73	635	51	585	62	589	90	994	276	2803
Total	108	934	70	910	99	997	99	1036	376	3877

ACCOMPLISHMENTS: SEED AND FERTILIZER SECTION

The mission of the Seed and Fertilizer Section is to improve the profitability and sustainability of agriculture in the state by ensuring the seed, fertilizer, lime, and other soil additives offered for sale in North Carolina meet prescribed standards and are properly labeled.

The mission of this section is accomplished by:

- Ensuring that all locations that offer seed, commercial fertilizers, agricultural liming materials, landplaster, and soil additives for sale in the state are registered.
- Implementing a sound regulatory compliance program by conducting inspections and sampling of seed and fertilizer offered for sale in the state.
- Implementing seed purity, germination, and other specialized laboratory tests in support of the seed regulatory and service programs.
- Implementing a joint federal/state administered biotechnology permitting and inspection program.
- Conducting the fertilizer bioassay and endophyte testing programs.
- Coordinating activities of the N.C. Seed Board such that complaints regarding the failure of agricultural or vegetable seed to produce or perform as labeled or warranted are heard and responses are provided.

The Seed and Fertilizer Section includes 25 staff members with responsibilities and accountability for administration, field services and North Carolina Seed Lab functions. The total budget for the Seed and Fertilizer Program for 2015-16 was \$1,623,252 including a state appropriation of \$688,896 and receipts of \$934,356. Revenues included receipts from licenses, registration fees, and tonnage fees.

Seed and Fertilizer Field Programs

During the fiscal year 2015-16 the Seed and Fertilizer Section remained very active providing services to producers and individuals within North Carolina and some service to non-residents of the state. Administrative staff was responsible for issuing 4,562 licenses for business that sold wholesale and retail seed. During the 2015-16 fiscal year 525 fertilizer licenses were issued to companies manufacturing or distributing fertilizer products. These products were sold through chain and private retail outlets and through 215 farm supply outlets.

Seed and Fertilizer Field Staff are responsible for conducting inspections and sampling seed and fertilizer offered for sale in the state. The staff also implements a regulatory program to ensure full compliance with laws and regulations. An overview of program accomplishments is provided in Table 34.

Seed and Fertilizer Field Staff also provided support to the North Carolina Department of Transportation by collecting 274 samples from 34 seed lots to be utilized on highway projects. The lab tests performed on these seed lots detected several violations and as such remain a critical part of the program.

Table 34 Seed and Fertilizer Program Inspection and Regulatory Activities, FY 2015-16

Number of Seed and Fertilizer Dealer Visits:	5,879
Seed and Fertilizer Samples collected	
Official Seed Samples	2,151 (55,212 lots)
Official Fertilizer/Lime Samples	1,716 (37,955 lots)
Regulatory Compliance Program	
Seed Stop Sales Issued	59
Seed Stop Sales Issued and Resolved on Site	1,506
Seed Stop Sales (N.C. Seed Lab)	223
Fertilizer Stop Sales Issued	36
Fertilizer Stop Sales Issued and Resolved on Site:	98

Table 35 and Table 36 provide additional information on fertilizer and lime samples taken by field staff and subsequently analyzed to ensure compliance with applicable statutes and regulations.

Table 35 Data of fertilizer samples analyzed for the current and previous fiscal years

FERTILIZER SAMPLING AND TONNAGE						
Year	#Samples	#Compliant	%Compliant	Tonnage Reported	Tonnage Sampled	%Sampled
2015-16	899	605	67.30	1,504,612	13,809	0.92
2014-15	1,081	730	67.53	1,497,209	18,862	1.25
2013-14	1,374	1,058	77.00	1,509,378	22,309	1.48
2012-13	1,228	868	70.68	1,378,111	21,920	1.59
2011-12	1,195	876	73.31	1,243,164	56,762	1.50
2010-11	1,437	1,019	70.90	1,295,362	33,170	2.56
2009-10	1,651	1,141	69.11	1,251,026	26,539	2.12
2008-09	1,484	1,069	72.52	1,073,286	35,598	3.32

Table 36 Data of lime and landplaster samples analyzed for current and previous fiscal years.

LIME SAMPLING AND TONNAGE						
Year	#Samples	#Compliant	%Compliant	Tonnage Reported	Tonnage Sampled	%Sampled
2015-16	571	505	88.44	731,932	28,539	3.90
2014-15	587	510	86.88	741,188	28,757	3.88
2013-14	646	498	77.00	831,854	28,620	3.44
2012-13	692	615	88.87	825,596	33,941	4.11
2011-12	758	541	71.37	767,766	36,965	4.80
2010-11	895	724	80.90	793,925	43,680	5.50
2009-10	729	611	83.81	640,106	35,793	5.59
2008-09	871	720	82.66	687,605	43,295	6.30

N.C. Seed Laboratory

The North Carolina Seed Laboratory is responsible for providing laboratory support for both the regulatory and service areas including the state's seed dealers, producers, university researchers and consumers. The work of this laboratory provides critical seed testing data needed to make management decisions regarding seed stock and for labeling purposes. For 2015-16, the North Carolina Seed Laboratory conducted 3,197 regulatory seed tests and 10,960 service seed tests. These tests involve required testing for purity and germination. Multiple tests are generally conducted on each of the samples submitted with 14,147 individual tests carried out. Additional special tests included tetrazolium, accelerated aging, cool test of cotton, cold test of hybrid corn, phenol, Round-up Ready™ tolerance, sand, and moisture testing. There were 568 special tests conducted during the fiscal year. All official regulatory samples taken during the fiscal year 2015-16 represent testing for a total of 45,741,080 pounds of seed offered for sale in North Carolina. See Figure 36 and Figure 37 for more information on the various seed tests performed in the laboratory.

The Seed and Fertilizer Section continued to implement the endophyte testing service. A number of grasses, including tall fescue and perennial ryegrass, contain a fungal endophyte which has a beneficial relationship with the grass host. The tall fescue endophyte, *Neotyphodium coenophialum* (previously *Acremonium coenophialum*), lives exclusively inside plants, and can only be detected through laboratory analysis. This endophyte has been proven to give the plant insect, disease and drought resistance, as well as enabling the plant to be more tolerant of overgrazing. Though very beneficial to tall fescue plants, this endophyte produces chemicals which are toxic to a variety of animals. In North Carolina, fescue toxicosis is especially a problem in horses and cattle. A total of 9 pasture samples were processed for producers, both in-state and out-of-state.

The staff of the North Carolina Seed Laboratory remains active in the Association of Official Seed Analysts and the Association of American Seed Control Officials. At the state level, program staff remains active in the North Carolina Seedsmen's Association and the North Carolina Crop Improvement Association.

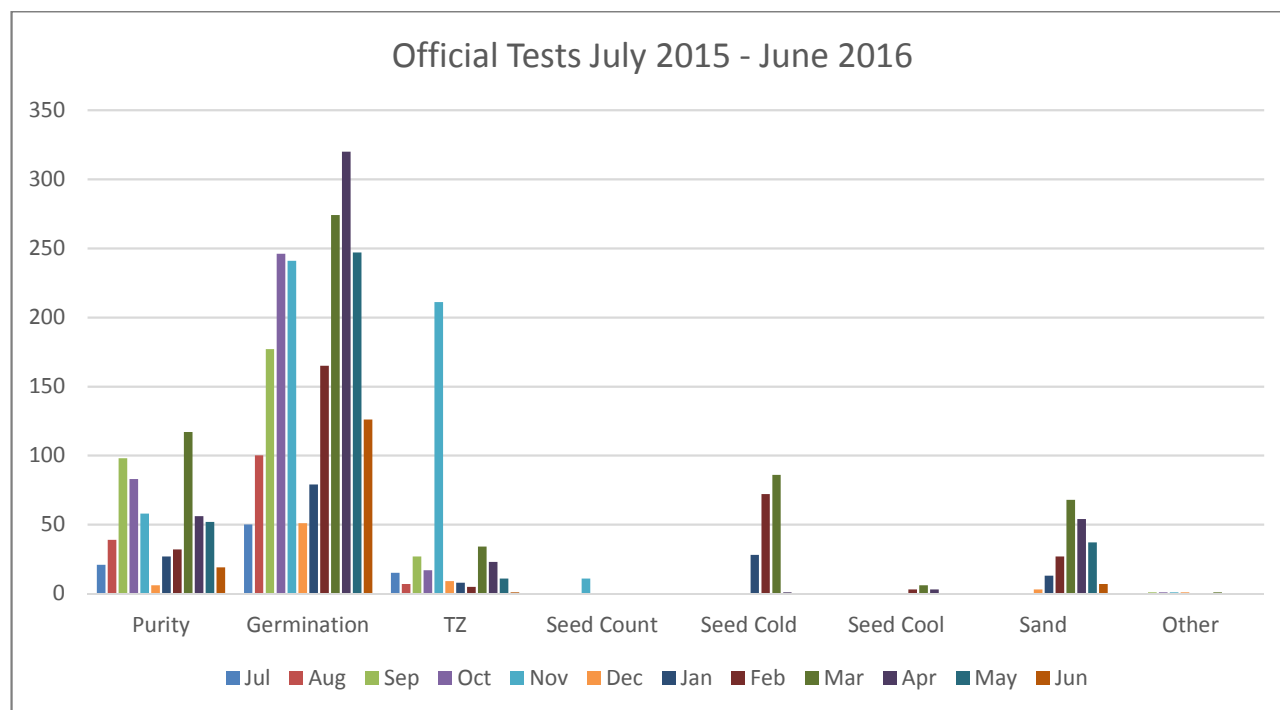


Figure 36 Seed Laboratory official tests.

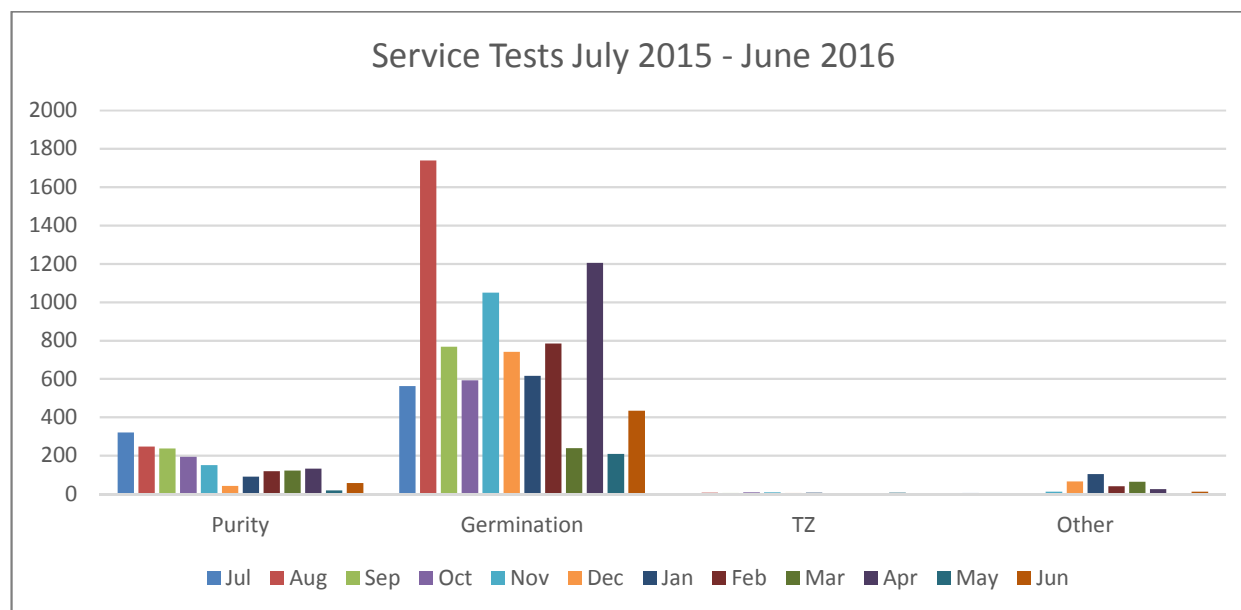


Figure 37 Seed Laboratory service tests.

Joint Collaboration with USDA, Biotechnology Regulatory Services

Seed and Fertilizer Section staff worked with USDA, Biotechnology and Regulatory Services (BRS) to jointly administer a federal/state biotechnology and permitting program. Primary responsibilities included reviewing permits and acknowledgements provided through USDA-BRS for laboratory, greenhouse, and field tests of genetically engineered crops. For this period, NCDA&CS staff reviewed a total of 250 notifications and permits. A joint project with USDA-BRS continued during this period involving NCDA&CS staff conducting field inspections of *Notification and Permit Release Sites*, including pharmaceutical/industrial trials. During this time period there were 3 field inspections conducted by NCDA&CS field staff. As a prerequisite for participation in the project, all field staff were required to participate in training conducted by USDA-BRS focusing on work flow, confidential business information, and steps in effectively completing a field inspection.

North Carolina Seed Board

The responsibility of the North Carolina Seed Board is to review complaints from individuals who may have suffered damage from the failure of agricultural or vegetable seed to perform as labeled or warranted, or as a result of negligence. Performance issues related to seed purity, seed germination, varietal purity, percent weeds, inert material, other crop seed and test date are potential issues to be addressed by the Seed Board. For the 2015-16 fiscal year time period, the Seed board conducted an investigation of one complaint that was filed in June, 2015 for carrot seed.

North Carolina Tobacco Variety Evaluation Program

The Tobacco Variety Evaluation Program continued in joint cooperation with N.C. State University. Samples from 24 flue-cured tobacco seed lots were obtained for planting grow-outs in the variety testing program. The Tobacco Seed Committee approved for sale in North Carolina a total of 46 different varieties from four different seed companies.